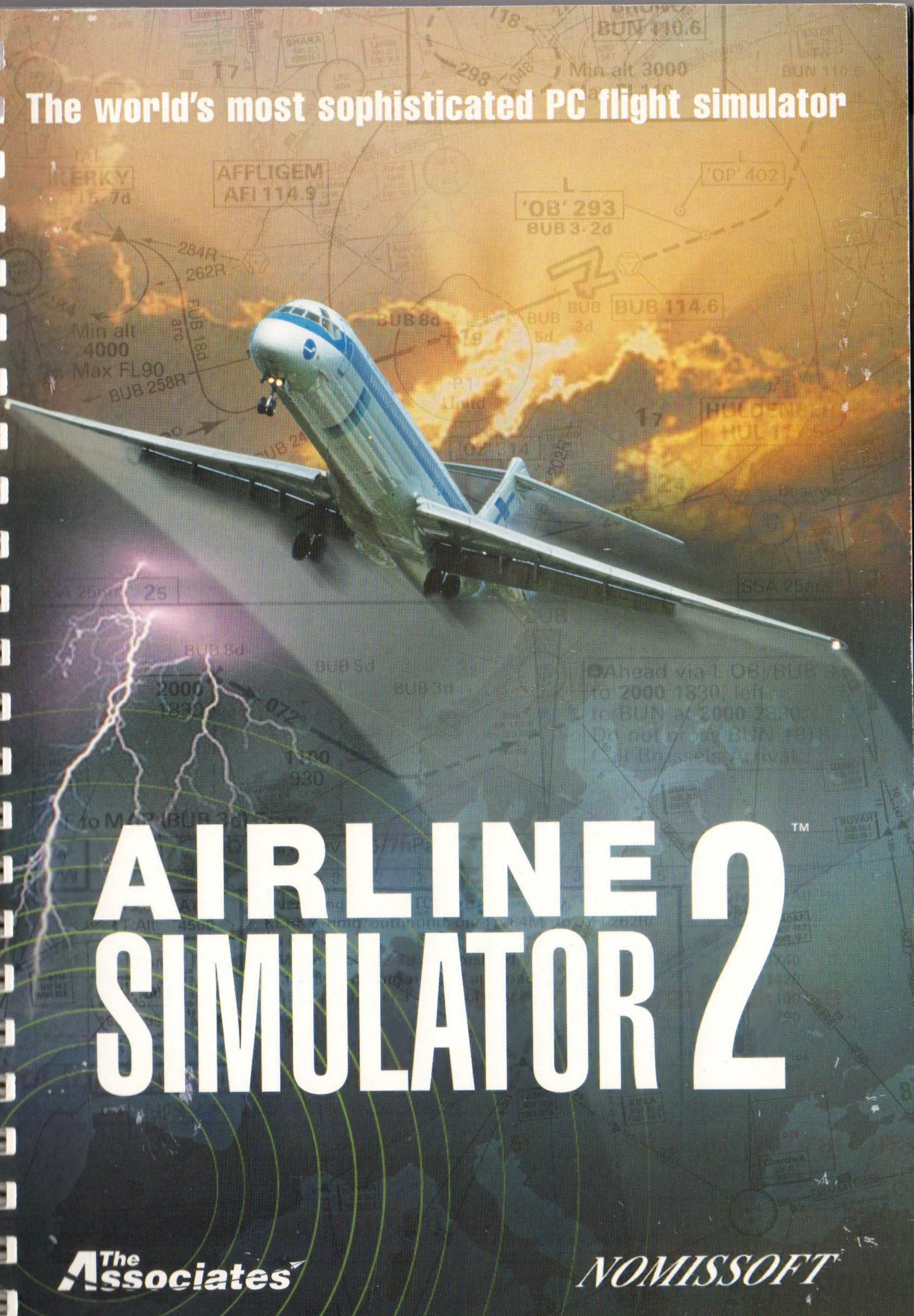
The world's most sophisticated PC flight simulator



AIRLINE SIMULATOR 2™

The Associates

NOMISSOFT

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Acknowledgments

Enroute and airfield approach charts included with Airline Simulator 2 are reproduced with the permission of RACAL Avionics Aerad, whose assistance is most gratefully acknowledged. As the information shown on aeronautical charts is subject to constant change it must be stressed that these charts are strictly for use with Airline Simulator 2 and must on no account be used for real-world navigation or operational purposes.

For further information on their products and services Aerad Customer Services Department can be contacted at the following address :

RACAL AERAD

Racal Avionics Limited
Aeronautical Services Group
Hersham House
Lyon Road
Walton-on-Thames
KT12 3PU
England
Telephone: +44 (0) 181 971 5522
Fax: +44 (0) 1932 267572

Credits

AS2 has been a major undertaking, for which many companies and individuals combined their efforts across nations and continents in a joint venture. The entire team wants to thank the design team of subLOGIC under the lead of Doug Meyers, who laid the foundations with the well known ATP, "Air Transport Pilot", which forms the basis for some of the code still being used in AS2.

AS2 Design and Programming
Simon Hradecky (NOMISSOFT, Austria)

AS2 Flight Models
Simon Hradecky (NOMISSOFT, Austria)

AS2 Aircraft Design
Umberto Colapicchioni (Virtuali, Italy)
Dominique Limat (Switzerland)

Instrument Panels
Simon Hradecky (NOMISSOFT, Austria)
Hans Kiener (Virtual Takeoff, USA)
Urs Wildermuth (Danur, Switzerland)
Umberto Colapicchioni (Virtuali, Italy)

AS2 Scenery Design and Development
Umberto Colapicchioni (Virtuali, Italy)
Jon Stratful (England)
Urs Wildermuth (Danur, Switzerland)
Simon Hradecky (NOMISSOFT, Austria)
Alberto Barbati (Virtuali, Italy)

Documentation
Urs Wildermuth (Danur, Switzerland)
Steve Garry (Huntsgrove Computing, Ireland)
Richard Cook (England)
Martyn Thomas (PCFlying, USA)
RACAL Avionics Aerad (England)

Data Research
Barry Adam (New Zealand)
Marc Brodbeck (USA)
Umberto Colapicchioni (Virtuali, Italy)
Richard Cook (England)
Hans Kiener (Virtual Takeoff, USA)
Allan Patnoe (USA)
Graeme Rodgers (New Zealand)
Jon Stratfull (England)
Urs Wildermuth (Danur, Switzerland)

ATC Voice
Simon Hradecky (NOMISSOFT, Austria)

ATIS Voice
Kerry Bax (New Zealand)

Ernie
Enrico Schiratti (Italy/Greece)
Simon Hradecky (NOMISSOFT, Austria)

Voice Commander
John Donovan (Island Imaging, Australia)

Testing Team
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Packaging and Documentation
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Getting Support

News, Announcements and FAQs (frequently asked questions and their replies) can be found at **http://www.airsim.com**.

A message board, libraries and online conferences are being operated by the developers in the Compuserve forum SimPilot: GO SIMPILOT or Internet URL **http://go.compuserve.com/simpilot** .

A free trial membership with Compuserve is included with this CD - in the directory CSERVE you'll find two software packages to connect to Compuserve: Compuserve 3.0.4 (German and English, IE 3.x included but not required, Win95 or Win98) or WinCIM 2.6 (English, Win3.x, Win9x and WinNT). To install either of these packages, select the appropriate directory and run the SETUP program. To sign up for your trial membership with Compuserve, use the password GRMPILOT.

Contents

Foreword

You will see personal remarks by the author of this manual talking about „Keeping the dream alive". Urs, when he wrote these paragraphs, didn't know, how close he came to the truth.

I got involved with Aviation when I was 18 years of age and had to serve my duty in military service. I got assigned to monitor radio traffic on aviation frequencies, and soon started to wonder about the background of commercial aviation. My interest went into the organisation of civil aviation - jet routes, flight levels, ATC operation and communications and a lot more. My profession however turned me away from aviation again initially. This got suddenly changed, when I learned about ATP from subLOGIC. My dream came alive again. Just, that now, I wanted to know more about how to operate an aeroplane, and how to co-operate with ATC.

The dream of being involved in aviation somehow now became more concrete in getting ATP improved. I started to research real world aviation in much more detail than I ever expected. The first result of this dedication has been 3DAGS.

Then I got invited into full flight sims. And I amazed the instructor there, that I could get the aircraft down onto the runway in one piece, and actually produce quite a respectable approach profile. So again, I was sent off, this time with a bit of crosswind - and I crashed with a loud bang provided by the simulator, after touching down exactly on the touch down point on the runway, but losing control of the aircraft immediately afterwards, when I had to counteract weathercocking effects .

How should I have been able to handle crosswind? PC's couldn't simulate ground handling in crosswind at all at the time. However, another dream was born at that day. I wanted a flight model, that is capable of real world handling techniques in all stages of flight, including taxi, takeoff, initial climb, level change, descent, final approach and landing roll to taxi again.

Three years of research were in between the dream, and the resulting flight model, which you can fly now in AS2. I shall leave it to experienced pilots involved in Alpha and Beta Testing of AS2 to judge the quality of the flight model - Urs has quoted some of the remarks that these pilots mentioned while performing their tests. I am simply happy, that I could fulfil one of my many more dreams with AS2, and surely hope, that you will find your dream having come to life, too.

Simon Hradecky

Keeping the Dream Alive

„Nothing can come close to the experience of advancing the throttles at take off, and feeling the surge of acceleration as the aircraft starts to move. Knowing that this is the moment you have been longing for since you saw that first light aircraft take off from the local farm strip. You can feel the power of the big jet engines moving this huge mass as if it were the natural thing to do. You can see the runway lights go by and the red end lights approaching but you know you will be long gone up into the sky before you reach them. Then, at the right moment, you pull gently but firmly on the massive control yoke in front of you. Slowly the nose of the aircraft starts to lift off the runway. Then, feeling the urge to leave the concrete behind, the main gear rises in the air as the wings lift. As the vibrations cease, you know you have reached into the third dimension of travel. You raise the landing gear and let the aircraft enjoy its element. Soon you are flying at almost the speed of sound, miles above the ground, flying to your destination..."

Does that sounds familiar? The history of flight simulation programs is one of unusual success. From the days that I first "took off" on my Sinclair Spectrum and later on the Commodore 64 to the days of multimedia PC's of today, flight simulation programs have been on the best seller lists. Many more people dream of flying than ever get the chance to pilot a small aircraft, let alone a airline transport jet. Before PC-based flight simulation, they were restricted to watching, now they can try it for themselves. 10 years of PC flight simulators have brought huge changes, in technology, scenery and capability, and the modern systems now give a real impression of flight. In that time, a huge community of fans and power users have shared unforgettable experiences like the Interstate Air Races, or the CompuServe Fora which have become a second family for many. It is there where the most dedicated people meet and ideas are born. This simulation is about to change YOUR experience from flying a PC simulating an aircraft to flying an aircraft on your PC.

Traditionally, Flight simulators have worked using a well defined system, based on huge data collections which tell the program behind each simulator what to do in a given situation. Let's say you fly level at 15000 ft and pull on your joystick. The program will read your input and then use a collection of tables to "look up" what to do; e.g. how to change the attitude, direction, speed and so on.

In order to fulfil the requirements for pilot training, a simulator must stay within 5% of the actual aircraft behaviour. That is, the fuel burn of the simulation must be within 5% of the real aircraft, and it must fly within 5% of the speed of the aircraft at specified heights and weights. Of course this means massive numbers of tables, all being checked by the program many times per second. Unfortunately, these tables are huge and clumsy to work with. That is fine if you have a few million of whatever currency you like to spare and a supercomputer to run it with. On a PC-based Simulator it is a completely different story: Up till now, most simulators have had to reduce the number and size of the tables, and this has affected the accuracy of the „flight model", which often means restrictions on the flying qualities outside „normal" flying situations, and even within normal conditions they cannot always meet the 5% tolerances. Another reason for these limitations is the non-availability of the tables and data, either because they are beyond the cost reach of many development teams, or, more often, they simply don't exist.

Airline Simulator 2, however, uses a purely mathematical approach. There are virtually no tables to look up, but only mathematical equations which are combined to make up the flight model. That means you no longer need massive numbers of tables and data, only a very good set of measurements of all parts of the aircraft. It also means that you can do all sorts of things to that aircraft (such as fitting different engines or even different aerodynamic surfaces) without having to rely on data packages that no one ever dreamt of creating....

This technology is not new, but until now, it has been limited to being used by aircraft designers and some of the simulators used by the airlines. Even then, not all of them share the full capabilities of AS2, which is capable of manoeuvres which have proved impossible to simulate accurately in the multi million dollar motion simulators. Now this technology is available on your PC for a fraction of the pricetag.....

Probably the easiest way to explain to you the difference between conventional simulation technique and what you see in front of you is to report the comment of a German airline captain after test flying an early beta version of AS2: „At first it did not behave as I thought, but once I realised I had to fly it like an AIRCRAFT instead of a SIMULATOR, I felt right at home!"

Airliners do not usually fly around their local airfield, they tend to fly significant distances between the airports of major cities. That is why Airline Simulator 2 comes with a completely new scenery database covering large parts of Europe, the Atlantic Ocean and the USA suitable for airline flying.

AND NOW. PLEASE READ THE MANUAL.

Before you jump in and try it out, bear with me for one moment. Airline Simulator 2 is a major step in simulation technology.

To get the best results from this simulation, you will have to use many of the details provided here. Please read the instructions before jumping in and going for it.... This manual was written to give you the information you need.

Now, strap into your favourite pilot's seat, take a deep breath, and LET's go fly!

Urs Wildermuth, May 1999

WHAT IS NEW?

If you are a user of AS1, 3DAGS or the earlier ATP versions then you may be wondering what is new to this program. In short: A lot has changed significantly.

- The new FLIGHT MODEL, long awaited by the flight sim community is now available for you to put to the test. Feel the real MD83 and B747-400 jetliners in their element; a total new world awaits you.
- Differential engine thrust, fully modelled engines and airframes and much more make this flight model superior to many professional systems.
- Redesigned Avionics offer new features previously unheard of in the entertainment market: Flight Management System, Flight Director, CATEGORY III AUTOLAND, VNAV and LNAV are all featured without the need to buy any add on products.
- A new 256 colour scenery system gives new feel and looks to the most complete European scenery available to date. It also gives new looks and life to your existing ATP AROUND THE WORLD, SWITZERLAND, and any other subLOGIC scenery.
- New weather effects such as rain and snow, icy runways, remodelled turbulence and winds add additional thrill to your career assignment flights.
- Improved Memory Management allows full Windows 95/98 compatibility and no hassle installation!
- NEW VESA 800 x 600 resolution support brings high resolution drivers to all VESA compliant PC systems while fully retaining the accelerator drivers featured in earlier releases.
- NEW Sound engine brings highly sophisticated sound generation to all known sound cards.

All in all: a new full product for you to enjoy and fly for a long time to come.

The Basics.

1. Installation

Installation of Airline Simulator is easy, however we need to highlight a few specific guidelines which you may need to consider. Please read these paragraphs carefully before you proceed.

To install Airline Simulator 2 onto your system or run it quickly off the CD simply insert the CD-ROM into your CD-ROM drive.

If you run Windows 95 or 98, you will automatically be presented with an installation screen, and the programme will auto install.

If you run DOS or Windows 3.x please make sure you have a DOS prompt on the screen, change to your CD-ROM Drive and run the INSTALL.BAT batch from the CD.

For a standard installation under Win9x, the Setup program will start automatically (if you have autostart enabled with your CD-ROM drive). If you want to do just a quick run off the CD, click that button, but you won't be able to log any assignment results or write a logbook entry. For a full installation onto the harddrive (recommended), click the button install. You will not have to make any further choices. AS2 has been carefully preconfigured to run with most systems without changing the default set-ups. The standard installation installs a VESA compatible graphics driver and also checks the settings on your sound card. For experienced users owning a graphics card based on ATI Mach32, ATI Mach64 , ATI Rage (not Rage 128) or S3 (not S3 Virge) , accelerator drivers are available, see Appendix: Advanced installation.

Once you have installed Airline Simulator 2, start it by clicking the icon on your desktop or, if you are in DOS mode or run DOS, changing to the AIRSIM directory and starting the program by typing AS2 [ENTER].

Notes for system configuration in the event of memory problems.

Airline Simulator 2 runs as a DOS application, and it will set some options within Windows to allow it to use the resources it needs. Normally, the install program will determine the correct settings and create the necessary system configuration for you. However, If you are not using Windows 95/98 or have problems with Windows 95/98 please review the following notes about memory configuration.

1. How much Memory, and which types of memory do I need?

AS2 needs at least 4 MB of XMS Memory and 3 MB of EMS Memory. XMS memory is generated by a driver in your Config.sys. Its name is HIMEM.SYS. Make sure the line DEVICE=C:\WINDOWS\HIMEM.SYS is present (possibly with a different path name). EMS Memory needs a different driver called EMM386.exe. It also needs to be in your Config.sys file and requires certain parameters to do the things it is has to for AS2 to work.

A line DEVICE=c:\WINDOWS\EMM386.EXE RAM or similar is needed in your config.sys file.

If you need to check these items, run the SYSEDIT command at the RUN Prompt in Windows.

2. Menus and Keyboard Commands

All the controls on the aircraft panels can be operated by use of a mouse. This method is to be preferred over keyboard, as it is faster, and less distracting than multiple key presses. However, if you want to use the keyboard, or need to know the keypress commands for an EPIC add on card, the following sections list the keypresses.

MOUSE CONTROL

Mouse handling:

To Push knob	Click Mouse with CTRL key pressed
To Pull knob	Click Mouse with SHIFT key pressed

Rotary controls can be operated by selecting the correct position around the outside of the knob with the mouse pointer, and then clicking the left mouse button. The buttons have 2 levels of change that can be applied. In each case, to increase by the large increment, position at 2 o'clock and click. To decrease by the large increment, position at 11 o'clock and click. To Increase by the small increment, position at 5 o'clock, and to decrease by the small increment, position at 7 o'clock and click.

In theory, it is possible to also operate the primary flight controls with the mouse, but we would not recommend this method of control, as the mouse is needed for other functions for too much of the time.

Primary Flight Controls.

The primary controls for each aircraft are elevator, aileron and rudder. On the keyboard, the main controls flight controls are activated on the numeric keypad to the right. Please note that while it is possible to fly from the keyboard, the speed of a modern jet, and the accuracy of the flight model combine to make it very hard to fly accurately without at least a joystick and throttle unit. If you intend to fully explore the capabilities of the new aircraft in crosswinds and turbulence, then we STRONGLY recommend that you use a full set of flight controls including rudder pedals. If you are using a joystick of any sort, you MUST enable it every time you start the simulation, even if it is already enabled in Windows.

Keyboard Control:

7 Trim down	8 Elevator down	9 Increase Thrust
4 Aileron left	5 Aileron and Rudder centre	6 Aileron right
1 Trim up	2 Elevator up	3 Reduce Thrust
INS Extend Spoilers		DEL Retract Spoilers
- Retract Flaps		+ Extend Flaps.

By default, the rudder is normally connected to the ailerons in Auto Co-ordination mode to allow the use of the program without rudder pedals, But, this may cause you severe problems if you attempt any cross wind landings. Auto co-ordination can be switched off using the \ key. Once it is off, the rudders are steered via the keys:

< left	L neutral	> right
Nose wheel steering enabled	SHIFT /	(See Notes later)

Please note this new option that has been introduced for ground handling (ONLY on the new aircraft). On most modern large aircraft, the nose wheel can be controlled by both the rudder, and by a separate tiller steering system. The angle of turn that can be applied to the nose wheel by the rudder system is normally only about 7 degrees either side of centre, with the tiller option engaged, the nose wheel can be turned through more than 80 degrees either side of centre. This option is selected from the keyboard, and it is automatically disabled if the speed goes above 60 Kts, or if the engines are set to more than 50% power. The Rudder indicator is changed from yellow to Red when this option is active

The other primary controls are located on the main keyboard.

Raise Gear	]
Lower Gear	[
Reverse Thrust:	0 followed by 9
Cancel Reverse	0
Idle Thrust	0
Full Thrust	Backspace
Set Climb Power	I
Wheel brakes	M

Additional Primary Controls for MD83/95 and B747-400

Engine 1 Start	E 1
Engine 2 Start	E 2 (and same for engines 3 and 4)
Engine 1 Shut Down	O 1
Engine 2 Shut Down	O 2 (and same for engines 3 and 4)
Set Parking Brake	B
Push Back from Parking position	ALT P
Select EPR Gauge	ALT 1/2/3/4 (On Numeric keypad)
Select Fuel Gauge/Zero Fuel Weight	ALT 9 (On Numeric keypad)
Increase EPR Bug / ZFW fast	ALT =
Decrease EPR Bug / ZFW fast	ALT -
Increase EPR Bug / ZFW slow	ALT (
Decrease EPR Bug / ZFW slow	ALT)
Toggle Window/Glareshield on /off	ALT 4 (On Numeric keypad)
Aileron Trim	CTRL Cursor Left/Right
Centre Aileron Trim	CTRL Cursor 5
Rudder Trim	CTRL </>
Centre Rudder Trim	CTRL L

MD83/88 specific controls:

Toggle Automatic Reserve Thrust (ART)	ALT 8	(numeric keypad)
Reset Fuel Used	ALT 5	(numeric keypad)
Select Thrust Computer active	ALT 7	(numeric keypad)
Select Assumed Temperature	ALT 6	(numeric keypad)
Select Fuel gauge/gross weight	ALT 9	(numeric keypad)

2.1 Simulation Controls

The Simulation Controls are the keys that control the simulator, not the aircraft. They are essential for the use of the simulator.

2nd Instrument Panel Switching	TAB
Automatic Taxi to active Runway (in Assignment Mode)	~
Pause (Freeze Simulator and Restart)	P
Refresh Screen Display	Esc

All further Simulation controls use the ALT key.

Quiet (Sound Off)	ALT Q
All Sounds On	ALT E
Engine, Warnings, Voices only	ALT W
Start Demo Recorder	ALT I
Stop Demo Recorder	ALT O
Cycle through and select Demo Time	ALT T
Joystick enable/disable	ALT J
Joystick calibrate	ALT N

(The installed options for the Joystick can be found in menu AIRCRAFT (F6) Option 6)

Visual Attitude Indicator on /off	ALT A
Scenery Load	ALT L
Cruise Mask (all objects enabled)	ALT ;
Final Approach Mask (Runway only)	ALT ENTER
Increase Complexity	ALT >
Decrease Complexity	ALT <
Shader On / Off	ALT Caps Lock
Slew Mode On / Off	ALT S
move forward / backwards	8 / 2 (Num. Keypad)
move left / right	4 / 6 (Num. Keypad)
Altitude up / down	Q / A
Stop all Motion	5 (Num. Keypad)
Heading increase / decrease	1 / 3 (Num. Keypad)
Pitch up / down	9 / 0 (Keyboard)
Roll left / right	7 / 9 (Num. Keypad)
Reset Pitch / Bank / Heading to Zero	Z
Digits on / off	D
Accelerate Time	ALT + (Num. Keypad)
Decelerate Time	ALT - (Num. Keypad)
16 x Time	ALT INS (Num. Keypad)
Reset 1x Time	ALT Del (Num. Keypad)
Exit Program or CTRL Break, then 1	ALT X
Load Hotkey Modes	ALT CTRL (1-9)

The Complexity of the Scenery display can be regulated according to processor power. The faster 486 and Pentium PC's no longer require these options but they are given here for completeness.

Additional Simulation Controls for MD83/88 and B747-400

Repair Aircraft (on Ground and Parking Brake set)	ALT R
Toggle First Officer's voice On / OFF	ALT F
Glideslope Inhibit (a GPWS switch)	ALT G

2.2 NAVIGATION CONTROLS

All Navigation and View Controls are activated in conjunction while holding the SHIFT key. Most navigation equipment can and should be changed with the mouse. All keys are situated on the normal keyboard.

Choose Device:

NAV 1	SHIFT 1
NAV 2	SHIFT 2
DME	SHIFT 3
ADF	SHIFT 4
IRS/Toggle HSI between NAV/FMS source	SHIFT 5
RMI 1	SHIFT 6
RMI 2	SHIFT 7
Heading Bug	SHIFT 8
Airspeed Bug	SHIFT ;
Radio Altimeter Bug	SHIFT '
Turn on audible navaid ident	SHIFT I
Turn off audible navaid ident	SHIFT O
Increase / Decrease Full MHz or Bug	SHIFT = / -
Increase / Decrease Fractional MHz or Bug	SHIFT [/]
Increase / Decrease OBS setting	SHIFT 9 / 0
Increase / Decrease Altimeter Setting	SHIFT < / >
Increase ND range	SHIFT E
Decrease ND range	SHIFT R

2.3 MENU SELECTION (FUNCTION KEYS)

Flight Modes Menu	F1
Mode Library Menu	F2
Environment Menu	F3
View Menu	F4
Graphics Menu	F5
Aircraft Menu	F6
Flight Planning Menu	F7
Status Report	F9
Help Menu	F10

2.4 VIEW CONTROLS

All View Controls use the SHIFT key. Adjustments of zoom and priority only affect the active window.

First 3D Window On /Off	SHIFT Backspace	
2nd 3D Window On / Off	SHIFT Num Lock	
Map Window On / Off	SHIFT Scroll Lock	
Select Window	SHIFT Ins	
Give selected Window top overlap priority	SHIFT P	
Increase Zoom	SHIFT +	(Num. Keypad)
Decrease Zoom	SHIFT -	(Num. Keypad)
Reset 1x Zoom	SHIFT N	
Select View (Cockpit, Tower, Spot)	SHIFT Caps Lock	
Move Tower Position on present Position	SHIFT -	(only in Tower Mode)

Selected 3D Window Cockpit View Direction:

SHIFT and Num Keypad Key:

7 left front	8 front	9 right front
4 left	5 down	6 right
1 rear left	2 rear	3 rear right

Adjust Selected 3D Cockpit View :

SHIFT and

	T	up		
F left	G	reset	H	right
	B	down		

Additional Controls for MD83/88 and B747-400

Switch Glareshield on and off	ALT 4	(keyboard)

2.5 AUTOPILOT

Controls for MD-88 and subLOGIC Aircraft

Master Switch Engage / Disengage	SHIFT Y
Lateral Mode Cycle (toggles between HDG BUG, NAV2, OFF) (NAV 1 is not selectable at this time)	SHIFT X
Altitude Hold On / Off	SHIFT C
Autothrottle On/Off	SHIFT V
Approach Mode On/Off	SHIFT S

Controls for MD83 and B747-400

Flight Director On/Off	SHIFT W
Flip Autopilot Masterswitch	SHIFT Z
Flip Autothrottle Master Switch	SHIFT V
Select TOGA	SHIFT D
Select Speed Window	SHIFT S
Select Heading Window	SHIFT X
Select Vertical Speed Window	SHIFT C
Select Altitude Window	SHIFT A

Master Control Panel Keys MD-83

With Thrust Window active

selects Speed Mode	SHIFT F1
selects Mach Mode	SHIFT F2
selects EPR LIM	SHIFT F3
toggles speed-mach for preselect) (push knob into second detent	SHIFT F9

With Hdg Window active

Select NAV Mode (LNAV)	SHIFT F1
Select VOR/LOC Mode	SHIFT F2
Select ILS	SHIFT F3
Select Autoland	SHIFT F4
Reduce Max. Bank Angle by 5 degrees (min. 10 degrees)	SHIFT F7
Increase Max. Bank Angle by 5 degrees (max. 30 degrees)	SHIFT F8
Activates Hold of current heading (push knob)	SHIFT F9
Activates selected Heading (pull knob)	SHIFT F10

With Vertical Speed Window active

Activates Vertical Speed	SHIFT F1
Activates IAS Hold	SHIFT F2
Activates Mach Hold	SHIFT F3
Activates Altitude Hold (V 0000)	SHIFT F4

With Altitude Window active

Toggle AP1/AP2	SHIFT F1
Active Turbulence Mode (Vertical Speed Window becomes Pitch input fly pitch and thrust only).	SHIFT F2
Arm Altitude (pull knob)	SHIFT F10

For further information refer to the AOM section of the MD 83

Master Control Panel Keys B747-400

General rule of layout: Left upper key besides active window gets selected by F1, left lower key by F3, right upper key by F4, right lower key by F6, directly below window key F9 (push hold button) and F10 (push rotary button).

With thrust window active

selects Thrust Mode	SHIFT F2
selects Speed Mode	SHIFT F3
selects LNAV	SHIFT F4
selects VNAV	SHIFT F5
selects Flight Level Change	SHIFT F6
toggles speed-mach	SHIFT F9

With Hdg Window active

Reduce Max. Bank Angle by 5 degrees	SHIFT F7
Increase Max. Bank Angle by 5 degrees	SHIFT F8
Activates Hold of current heading	SHIFT F9
Activates selected Heading	SHIFT F10

With Vertical Speed Window active

Activates Vertical Speed	SHIFT F1
Activates IAS Hold	SHIFT F2
Activates Mach Hold	SHIFT F3
Activates Altitude Hold (V 0000)	SHIFT F4

With Altitude Window active

Activate Localizer Capture	SHIFT F5
Activate Autoland	SHIFT F6
Select Altitude Hold	SHIFT-F9
Activate selected altitude	SHIFT-F10

For further information refer to the AOM section of the B747-400

2.6 Communication with ATC

All Communication Controls are performed while holding the Ctrl. key.

Select COM 1	Ctrl 1
Select COM 2	Ctrl 2
Select Transponder	Ctrl 3

Frequencies should be tuned with the mouse whenever possible.

Full MHz	Ctrl = / -
Fractional MHz	Ctrl [/]
"Roger" (Read Back)	Ctrl ENTER
Repeat last message	Ctrl Caps Lock
Request clearance	Ctrl X
Contact new ATC facility	Ctrl TAB
Request taxi	Ctrl .
Request different runway	Ctrl -
Request new altitude	Ctrl A
Report leaving altitude	Ctrl Q
Request frequency change	Ctrl F
Request radar vectors	Ctrl V
Report traffic / runway in sight	Ctrl T
Report missed approach	Ctrl M
Request taxi to ramp	Ctrl ,
Cancel assignment	Ctrl C

2.7 Colour palette Selection

256 Colour Mode On	ALT 2	Main Keyboard
3 D Mode On (requires 3D goggles)	ALT 3	Main Keyboard

3D effect information.

Please note that the 3D effect is simulated by using a colour splitting technique that is then recognised when wearing the special glasses provided. However, it may be the case that you will not see the 3D effect immediately, this is not a fault with the machine, and not a fault with your eyes, it takes a while for the brain to recognise the change that has happened, and to adjust the manner in which it recognises the information it is receiving. Initially, you may have to look at the screen for as long as 10 minutes before the "switch" will occur, with practice, this will reduce to only a few seconds.

If you have a colour blindness problem, it is possible that you will not be able to get the 3D effect to work for you, as it uses a red/ green split, and these are the colours most affected by colour blindness problems.

CAUTION.

If you suffer from any form of Epilepsy, or have problems when exposed to strobe style lighting, please consult your medical adviser before using the 3D effect.

3. Simulation Controls and Menus

3.1 Slewing

The Slew mode is intended for quick repositioning of the aircraft while remaining in the simulation. Once activated, by using the key combination ALT S, the top left hand corner of the external view window will display the current position co-ordinates to help with positioning, and to act as a reminder that the slew mode is active. The aircraft can now be moved as follows: (All numbers refer to the numeric keypad):

Altitude adjustment:	Q up	A down
Heading change:	1 left	3 right
Pitch	9 increase	0 decrease
Reset all 3 axes to zero	Z	
Move forward / backward	8 forward	2 back
Move left / right	4 left	6 right
Stop all motion	5	

3.2 Demo recording

In a restricted way you can record short demonstration flights. Position the aircraft on the start position and press ALT I. Then fly the desired demo flight, and press ALT O once you have finished the flight. A window will appear asking for a filename. The simulator will save the Demo accordingly.

It is important to understand that the Demo recorder only records keystrokes, no mouse or joystick inputs are recognised.

In order to replay the demo use the F1 Menu, Option 5 "DEMO LIBRARY" You will find a complete list of all available demos.

3.3 Joystick Controls

The Joystick has to be started manually at each start up. In order to do this, enter ALT J after you have exited the start-up demo.

Then check the function of rudder and throttle if available. If the Joystick is not centred, reset all the controls to home position, close the throttle and press ALT N to centre the electronic sensing of the joystick. Then try the new setting. If the stick does not reset, open the F2 menu and disable the option „load mode sensitivities" at the bottom and try again. Any other options concerning joysticks are selected in the F6 menu, option JOYSTICK. Using this option, you can change the sensitivities of the sticks or set the exact configuration of your hardware.

Please note that these options MUST be correctly set, and the joystick enabled EVERY FLIGHT, even if you have already entered and calibrated your joysticks using a manufacturers routine, or if you have also used a Windows 95 or 98 joystick setup routine

3.4 MENU F1 Flight Modes

The "Modes Menu" is selected with the F1 key. It controls the main features of the Simulator. Any option which has a small + sign in front of it is active.

AUTO FLIGHT	Automatic flight from A to B.
Single Assignment	Allows the selection of a single assignment. (See chapter 7)
Career Assignment	See chapter 7
Demo Library	Demo library, see chapter 6.2

The sub options are:

DEMO PLAYBACK	Replays the desired demo
DEMO LOOPING	Plays the demo endlessly.
Rename Demo	Changes the demo name
Delete Demo	Deletes a demo
Recording Interval	Sets the recording interval.
Instant Replay	Replays the last few seconds of a flight
Quit	Exit from the program.

3.5 Menu F2 Mode Library

Flight modes allow you to save flight situations with their associated parameters, and they can be recalled at any future time. The Mode Library, which can be selected using the F2 key, is intended for this purpose.

There are two kinds of modes.

The normal modes are listed as "Available Modes" on the right hand side of the screen. They are selectable as needed.

The "HOTKEY MODES" can be loaded with the 9 modes you might want to use most regularly. They can be recalled directly by using the combination "CTRL + ALT + Number (1-9)" while operating in the simulation, without having to call up the mode library first.

You can see which mode is active for hotkey and normal modes by the small + sign to the left of it.

The mode library options are as follows:

1 Next Hotkey Mode	Moves the + sign to the next Hotkey Mode
2 Next Available Mode	Moves the + sign to the next available mode.
3 More Available Modes	Shows the next page of available modes.
4 Set Hotkey Mode	Sets the selected available mode to the selected hotkey mode.
5 Rename Mode: (Name)	Renames the indicated available mode.
6 Delete Mode:(Name)	Deletes the selected available mode.
7 Create Mode	Creates a new mode. Move the aircraft to the position of your choice, press F2 followed by 7 and enter a title.
8 Reset Using Mode:(Name)	Resets the simulator using the indicated mode. This is the way to call a mode: Press F2, then the keys 2 or 3 until the desired mode has the + sign next to it and is also shown next to option 8, then press 8 to reset the mode.
9 Save Start Up Mode	Specifies the mode AS2 uses at start up.
A Use Mode Sensitivities	The sensitivity of the joystick is saved with the mode. If you want to reload the sensitivities, make this option active. Be aware that this option might prevent calibration using ALT N.

3.6 F3 Menu Environment

In this menu you can change all the environmental parameters such as time of day, season and weather. You call it up by using the F3 key. The menu shows the following options:

1. Auto Weather: OFF	Switches a random weather generator on or off. Normally, the weather is generated according to the season. For AS2 this means normally westerly winds with changing clouds. Options 6 to 9 are blocked if this option is active.
2. Daylight Control: OFF	This option overrides the clock for day, dusk and night scenery by selecting 3 default values. If the indicator is active, options 4 and 5 are ignored.
3. Reset Time/Date	Resets date and time to the computer clock. This is mainly used after career flights and mode changes where the time and date have been changed.
4. Time	Allows altering of time of day. If option 2 is off than this option will gradually change the day, dusk and night effects according to the selected date.

5. Date — Allows altering the date, which influences the day , dusk , night switching. The sunset and sunrise times are made based on a reference latitude of 40 degrees north.

6. Winds — Allows entering of complex wind structures. Generally winds have 3 parameters: direction, speed in knots and turbulence factor from 1 to 10. Turbulence generates gusting winds with increasing strength, 1 representing 4 kts and 5 represents 20 knots.

They are also separated in 3 layers

Surface Winds On the ground. Enter a desired depth which will set it active from Ground to the selected height AGL.
1. Layer 1. layer with upper and lower limit
2. Layer 2. layer with upper and lower limit.

7. Clouds — As with the winds, 2 layers of clouds can be defined. The parameters are: Coverage clear (1/10) to Overcast 10/10. Please note that AS2 operates in 10ths, and aviation meteorological reports normally give cloud in 8ths.
Tops /Bottoms in ft MSL
Deviation from the entered values.
This generates a random factor that is added to move the cloud base up or down within the maximum value given in the field.

Note. In order to get a realistic cloud base for an instrument approach to IFR minima, use the airfield elevation information from the status page, or the minimum elevation shown on the airfield map and then add 200 ft and set deviation to 50 ft. Cloud reports from an airfield normally report the height ABOVE the airfield, AS2 uses Sea level as the datum, so the airfield elevation must be added to any report.

Thunderstorms. This third cloud layer can also be given a movement direction and speed. The entered clouds will show on the weather radar in the cockpit.

8. Pressure — Actual Air pressure in inches of mercury. The standard value is 29.92" which corresponds to 1013 hpa. The altimeter shows both values in most aircraft.

9. Temperature — Outside temperature at sea level.

3.7 F4 Menu Views

This menu allows adjustment of windows and view options.

Option 1 arranges the position of the spot aircraft. The mouse can be used to vary the position around the aircraft. The options altitude and distance define the vertical and horizontal distance to the aircraft. In order to see the effect, try the different settings and look at the result. The Spot Plane View is toggled by pressing the SHIFT CAPS LOCK keys twice This cycles through Cockpit to Tower and Spot Plane View.

Option 2 sets the Window Orientation and allows exact arrangement of the windows. The windows are:

1st 3D	Outside view from the Cockpit
2nd 3D	2nd 3D. Window. This window can be used to show any other view, such as tower, any other outside view, map view etc.
Map	Map view
Instrument Panel	Instrument panel on or off.
Control Position Indicator	Switches the control position indicator on or off.

The option table lets you specify the active windows using figures 1 to 5, options 6 to 8 change the size of a window and options A to E move the selected window. After selecting an option, the cursor arrow keys allow you to modify the window in the direction of the arrow. Try it with the first 3D window to see how these options work.

The further options of this menu are:

3. Window Titles	You can switch on or off window titles .
4. Control Position Indicator	Switches a control position Indicator on or off.
5. Full Screen External View	Switches the instrument panel off if tower or spotter aircraft view is selected and enlarges the view to full screen.
6. Autozoom Tower View	Zooms tower view automatically.
7. True 3D ON / OFF	Switches the 3D external view on or off. You need to use the special red/green glasses to view this effect.

3.8 F5 Menu Graphics

This menu was originally provided when PC's were a lot slower than the normal machine in use today, where the frame rate (visual update rate) was occasionally adversely affected. You can switch several levels of detail on and off in order to improve framerate. Normally this menu option can be left in automatic mode, (1 Auto Complexity ON). If for some reason (e.g. on a slower 486) you need to improve the frame rate, you can switch this option off and use options A - K to switch off parts of the landscape. Please note that the maximum frame rate that will be seen is between 18 and 19 frames per second, and no changes made to these options will improve on that figure.

3.9 F6 Menu Aircraft

This menu allows selection and modification of different aircraft parameters and the selection and calibration of the input systems that operate the primary flight controls. The options are:

1. Aircraft Library — It is here you can select the different aircraft. At the moment these are:

- MD 83
- MD 88
- B747-400

Also available are the old subLOGIC models of

- B737
- B767
- B747-300
- A320
- Shorts 360

These aircraft do not use the new flight model, and some of the functions such as the nose wheel steering system are not available on these aircraft.

2. Crash : OFF	Crash detection on or off. With the new models, crash detection allows for over stressing the aircraft, gear failures, tail strikes and other malfunctions. AAL aircraft will reset the mode only on heavy impact destroying the aircraft totally. Otherwise, the resulting malfunction such as stuck gear or flaps etc. will become active and the flight continues. With crash detection off, all the above effects are disarmed.
3. Aircraft Control	This option is no longer active for the new aircraft. For the other aircraft, it should be left on REAL. In the intermediate or easy mode the parameters are changed.
4. Aircraft Loading	Here the loading of the aircraft is determined. You may enter the results from the aircraft Load sheet here. The PAYLOAD window corresponds to the total of Passengers + cargo + mail, the FUEL LOAD option is used to enter the block fuel. Now verify if the total corresponds to the TOW figure on the Load sheet.
5/6/7 Sensitivities.	These options are used to switch the sensitivity of the primary flight controls, particularly the joystick option 6 which allows to switch the sensitivity for all 4 axis of the joysticks. It is very important to check, that the settings give you adequate rudder deflections for both AAL and the other aircraft.

While it is possible to fly the aircraft using the mouse, it is NOT recommended to do so, as this makes responding to the many other control functions required much more complex.

For the AAL aircraft, using a CH-Virtual Pilot, set all axes to 5-6 in order to get the proper deflection. In the subLOGIC aircraft, the axis 1 and 2 should be set to about 3. Please experiment to find the setting which gives you best results. In particular, the NULL zone width should be set to the lowest possible value that works without the controls being offset from the centre position.

JOYSTICK and PEDALS

Important note regarding Joystick and Rudder Pedal settings.

After each program startup you MUST switch the Joystick on using ALT J. Check the effect with the rudder position indicator. If you want to calibrate the joystick, set all the controls to their zero or neutral setting (Throttle Closed) and press ALT N several times. If you use rudder pedals, you should disconnect auto co-ordination using the / key, in order to separate aileron and rudder controls.

3.10 F7 Menu Flight Planning

This menu is used to select scenery, to position the aircraft on other airports or to other places in the world, to use a logbook and further options related to flight operation. The options are:

1. Scenery Library

Used to select the active scenery manually or automatically. With your simulator you receive the default European 256 colour scenery. There are other sceneries available at your dealers.

Normally, scenery selection is set to automatic, so that sceneries are loaded whenever the need arises. If you use add-on sceneries, it might be necessary to disable automatic load. Please refer to the appendix for further information.

2. Position Using Lat Long

Positions the aircraft on a position entered using latitude and longitude. The Altitude Option allows to enter altitude above sea level. If it is set to 0, the aircraft is set to ground level.

3. Position using N/E

Uses the internal co-ordinates of the simulator. The airport list provided, and some sceneries like ATP Around The World use this system.

4. Locator

Here you can position yourself on one of the 26 primary airports. Choose the airport of your preference and press ESC to move to the place. You will be placed on a tarmac position or near the runway

5. 5/ 6 IRS

The IRS is an easy to use area navigation system with 4 waypoints. Like the positions they can be defined either with longitude and latitude positions or with user co-ordinates. Once the waypoints are defined, you may activate IRS by using the SHIFT 5 keys and by then selecting the active waypoint using SHIFT = or SHIFT - keys. The active waypoint will be shown on the IRS option on the MFD and will be used like a VOR on the HSI. The DME2 indication is now the distance to the selected waypoint. IRS can be used to locate airports without navaids. In other sceneries with long distances over the sea, it becomes a real long range navigational aid.

It should be noted that the IRS system is mainly intended for use with the original subLOGIC aircraft. For the new aircraft, IRS is not needed, as the LNAV function of the FMS is much far more capable than the IRS. However, the IRS can be used to navigate to waypoints or LAT/LON positions that are not part of the database of the FMC.

7. Logbook

You may use the logbook to record the details of your flights. It can be edited with this option. The entries are:
1. Enter Name:
2. Make Entry:
3. Review Log:

Please note that only whole hours are recorded in this log. Career flights are added to the logbook automatically.

8. ILS Preference

This option is used to specify if the left or right runway is to be used when parallel runways exist. The normal convention in AS2 is that runway labels 01 to 18 use Left or Right preference, whereas runways 19 to 36 use the reciprocal preferences. If the ILS is selected by Ident on the FMS, this option is set automatically.

9. Scenery Management System (SMS)

This system should be regarded as the primary positioning tool of AS2. You may position yourself to almost any location without having to enter co-ordinates manually. Additionally some other help functions are available.

The main screen of the SMS shows a list of all available waypoints and airports. You can either search for a desired waypoint using the arrow keys and then selecting it with the number next to it, or search for it directly by using the ALT key and by typing the name you are looking for. If you are looking for the airport Bristol, hold down the ALT key and type the letters of the name until it is displayed on the screen and then select it.

The main screen has some other functions as well: On top the information to be shown can be selected. All options featuring a + sign next to them will be displayed. You may display combinations of airports, VORs, NDBs, intersections or other waypoints.

Select different database	INS	Allows use of an alternative database.

Many add on sceneries come with their own database.

Make sure that the appropriate SMS file from the scenery (*.SMS) is loaded in the AS2\SMS directory (folder) when you install a new scenery.

Enter own position as waypoint.	Ctrl INS
Search function.	ALT.
Select the highlighted waypoint	ENTER

Once the waypoint has been selected, two different menus appear, depending on whether the selected waypoint is a navaid or an airport. In the case of an airport, the following options appear:
On top of the menu, information like name, frequencies, position and the internal co-ordinates are shown, below it runway information is shown. You may position on any of the runways by selecting it.

The other options are:

A Light Aircraft Visuals	Draws a traffic pattern on the elected runway for small aircraft.
B Heavy Aircraft Visuals	Draws a traffic pattern for heavy aircraft such as the AS2 aircraft.
C Disable Visual Approach.	
D,E,F,G Waypoints 1,2,3,4 Set IRS Waypoint.	Enters the selected position into the IRS
	Position the aircraft on the selected runway. ENTER

In the case of a navaid or waypoint, another menu will appear. On top are the same elements name, position, frequency if applicable.

The options are slightly different:

1 Set ADF / VOR Frequency	Sets the selected frequency on the ADF or VOR receiver.
2. Inbound Course to use	Select inbound course to use.
3. Distance to use	Distance in NM
A. Altitude	Altitude of the aircraft above sea level.
B. Heading	Heading of the aircraft.
C. Perform Selected Actions	Performs the selected actions and switches back to the simulator
D. Enable Visual Navaid Display	Shows the selected navaid visually in the scenery.
E,F,G,H Set IRS Waypoint	Sets the co-ordinates into the IRS on the desired waypoint
A USA Flight Assignments	This Option can only be used with the USA sceneries.

3.11 Status menu (F9) and Help Menu (F10)

These two menus are service menus giving different information about the simulation program and condition of the aircraft. The F9 menu offers information on the actual status of the aircraft with total weight, fuel on board, payload and many more. The F10 menu offers a help menu showing the menu titles of all functions keys

Flight School

Introduction

This part of the manual is divided into 2 sections. In the first section, we will introduce the new skills needed to prepare for a flight, and the preparation that is needed, and then introduce the flight deck automation that is available to help reduce the workload. Finally, we will discuss the basic skills and techniques that you will need to be able to fly a simple circuit and landing training detail, and show how with help from the automation, the workload in flight can be effectively managed.

The second section covers the differences in procedure that are needed to cope with failures and unusual circumstances. This includes flying with mechanical failures of some sort, and dealing with inclement weather situations.

Flying modern air transport category aircraft is a complex job, and there are many aspects to consider. On the one side, the modern airliners such as the B747-400 have a huge amount of automation to master, yet it is still an aircraft, which requires the basic flying skills that any aircraft requires. This chapter is designed to give you an overview of the basics of jet flying and how to master it in AS2. If we could get you in the air without covering some of these subjects, we would, but there are some basics that have to be covered in order to get you up and down again without a crisis in the middle. Please bear with us, and try to take on board some of the basics.

Please always remember that in the real world, all of the types we are simulating here have to be flown by a crew of at least 2 qualified pilots. There will be times, especially in the early stages of learning this simulation, when it will be necessary and appropriate for you to pause the simulation in order to catch up with what is happening, and prepare for the next stage of the flight. In a simulator, that can be done, and with the work load that you will experience operating these aircraft in a single crew scenario, it will be necessary.

In the real world, the handling pilot, who is the one manipulating the flying controls, will not normally have to do any operating of radios, Navaid tuning, or concern himself with things like operating flaps or landing gear. Here, you are going to have to do it all, and in the early days, you will have to work out what has to be done, instead of knowing it instinctively, and in that period of time, if it is not paused, the simulation may cover a large distance, and make it harder to finish the action that you were planning. So, in the early stages, if things are getting out of control, use the Pause Key, sort out the problems, and then continue the flight.

This manual is designed to help you fly and get the best from the AS2 simulation. It is not intended to teach you how to fly, or how to fly instrument procedures. If you are new to computer based flight simulation, you will need to do some reading of real world aviation books that cover these subjects, as we have assumed that users of this product are already aware of the basic concepts and principles of flight. While we have attempted to cover the basic principles of heavy jet operation in a commercial environment, we have not covered basic flying principles or the procedures needed for Instrument flight in any depth.

Normal Operations.

Pre-flight Tasks and Operation

Before such a demanding task as taking an aircraft on a flight, you need to start with the flight preparations. This includes all tasks of flight planning, load control, weather briefing and planning, and many more. However, in AS2 you are the captain, so many of these things get done for you. So you don't need to be concerned that before every flight you will have to sit for several hours preparing complex flight plans before you can get airborne. It strongly depends on what you want to do in detail and how you want to go about it. If you are doing some flight training out

of your home airport, you won't need to do a detailed flight log. You need to be aware of weather, load and you need to figure out how much fuel you need to complete your training. If on the other hand you want to do a complete flight from London to New York you should run through the appropriate preparations in order to make the trip stress free, and to ensure that you arrive at your destination with the correct fuel levels, and at the right location and time.

Flight Planning General

There are several ways to prepare a flight plan for AS2. While there are a lot of great flight planners around, such as Geir Granvik's PC Flightplan and others, there is one planner that comes directly with AS2 and allows you to print flight plans for all assignment routes. It is included in ATPUTIL 5.0. Please refer to the chapter describing it further along in the book.

Of course there are manual ways of flight planning also. In the aircraft specific sections you will find the performance tables that will help you to plan your trip properly:

- Tables that will return a trip fuel for a given distance and weight
- Tables that will return time fuel and distance to climb and descend
- Tables that will return the proper cruise power settings for given conditions.

Weight and Balance

Weight and Balance is an aspect of flying that has been excluded for too long in flight simulators, and this has lead to some severe and frustrating misunderstandings. Many of todays simulators don't take into account payload but fix a certain weight per aircraft. This is not very practical. A B747-400 flies quite differently when filled with passengers and fuel from the way it flies when empty. The following chapter introduces you to the basics of weight calculation as it is done in professional aviation and then covers how to include it into AS2.

Load and Balance in AS2.

Loading your aircraft is quite easy in AS2. All you need to do is to open the „AIRCRAFT LOADING„ option in the F6 (Aircraft) menu. On top of the menu, you will see the gross weight of the aircraft, and this will change whenever you change one of the options underneath it. You will see fields for payload and for fuel. Subject to the loading limits of the aircraft, these can be changed as needed for the flight,

In order to make a bit of sense of this, lets look at what is involved in loading an aircraft.

LOADSHEET

In commercial aviation for each flight a load and balance document, the LOADSHEET must be produced. AS2 is no different, however, the requirements are a considerably simplified. Each aircraft uses different loading limits. Let us now explore what kind of weights you will need for your planning.

DRY OPERATING WEIGHT (DOW)

The base for the weight and balance calculation. The DOW consists of:

The fully equipped empty aircraft + the Crew + the galley and contents

This weight is fixed in AS2 for each aircraft. You receive the already equipped and ready aircraft for your flight. For the respective limits please consult the weight and balance limits in the specific aircraft section.

This weight gets increased by the payload and fuel.

The PAYLOAD consists of:

Passengers and their luggage: Nominally 210 lb. per passenger

Most commercial airlines also will carry freight, and mail, but to simplify the planning process, the AS2 operator has decided that only passengers and their luggage will be carried.
The object of the exercise is not to exceed any of the weight limits that are laid down by the manufacturer.
These MAXIMUM LIMITING WEIGHTS are:

MAXIMUM ZERO FUEL WEIGHT (MZFW)	Maximum weight without fuel. Any weight above this must be fuel.
MAXIMUM RAMP WEIGHT (MRW)	Maximum weight on the ramp. This includes the fuel needed to get the aircraft from the gate to the runway.
MAXIMUM TAKE OFF WEIGHT (MTOW)	Maximum weight at brake release for take off.
MAXIMUM LANDING WEIGHT (MLW)	Maximum weight at touch down.

The table below gives you the figures for our aircraft in lbs.:

Aircraft	DOW	MZFW	MRW	MTOW	MLW
MD83/88	80 000	122 000	161 000	160 000	139 000
B747-400	401 000	563 000	872 000	870 000	630 000
A320	158 000	125 000	159 000	158 000	138 000
B737-250	60 000	90 000	115 500	115 000	100 000
B747-350	380 000	530 000	802 500	800 000	565 000
B767-250	180 000	250 000	301 000	300 000	270 000

The basic calculation is very easy indeed. All you do is to start at your DOW. Next thing you need to consider is payload. If you add up the DOW and Payload, you end up at your actual Zero Fuel Weight.

DOW + Payload = AZFW (Actual Zero Fuel Weight).

The AZFW is the base for the remaining calculations. It is always nice to know, because with it, and the amount of fuel indicated by the fuel gauges you always know your exact weight.

The next step is to determine the amount of fuel you need to complete your flight. For this, check your flight plan and take the following 2 values: The amount of fuel you need to reach your destination, we will call that one Trip Fuel or short TIF. Then you need to know the amount of reserve fuel for diversion, holding and so on. Added up, the 2 of them result in your Take Off Fuel or TOF.

Now we have all factors we need: AZFW, TOF and TIF. Add the TOF to your AZFW to receive your Actual Take Off Weight, then deduct the TIF and receive your Actual Landing Weight. The above calculation would look like this:

DOW(Dry Operating Weight)
+ Payload

= AZFW (Actual Zero Fuel Weight)
+ Take Off Fuel

= ATOW (Actual Take Off Weight)
- TIF (Trip Fuel)

= ALW (Actual Landing Weight)

The main issue now is to make sure that the aircraft is not overloaded in any of these. There are several major factors involved which in turn limit the actual take off weight for a given flight. Let's examine them briefly:

MTOW: This is the absolute maximum.

MLW: In order not to exceed the maximum landing weight you have to add the trip fuel you need to get your destination to it in order to get the applicable Maximum weight for take off. For example: If you know you need 50'000 lbs. of fuel to reach your destination in the B747-400 then the maximum weight you may have for take off is equal to MLW + TIF, that is 630000 lbs. + 50000 lbs. = 680000 lbs.

MZFW: The maximum Payload you can take on any aircraft is defined by the calculation of MZFW - DOW. The second calculation is to determine the Maximum weight for Take Off limited by the MZFW. For example if you need 100000 lbs. for your flight the calculation looks like this (for the B744) MZFW + TOF , that is 563000 lbs. + 100000 lbs. = 663000 lbs.

Knowing and using these calculations you can prevent overload situations. For any flight, first determine the 3 allowed weights for Take Off. You will soon see that it is not possible to do training circuits around the field with full fuel tanks. If you are aware of the above, you will never get into these situations in the first place.

The second variable in the Weight and Balance calculation is Balance. It is automatically handled by AS2 and need not be considered.

Ground Handling

Push back

Parking brakes, push back tractor, procedure, setting park brake

Keystrokes involved

B	set parking brake
M	normal brakes / release parking brake
ALT P	start push back

Immediately prior to departure, the aircraft will be secured with its parking brakes set. AS2 features a parking brake selector using the B key. While the parking brake is set the „Brake„ annunciator will be visible in the first 3D window. The parking brake is released using the M key.

At most international airports aircraft are parked with the nose pointing towards the terminal in order to gain access via the passenger air bridges or jetways. As the average aircraft has no rear view mirror and reverse gear like an automobile and rolling backwards using reverse thrust is not very popular as the engines can ingest foreign objects and suffer considerable damage that way, normally the aircraft is pushed back from the stand using a special tractor.

AS2 supports this feature using the ALT P key combination. When cleared to push back (or to taxi in the career flights) release the parking brakes using the M key. When the „brake„ annunciator in the first 3 D window is off press the ALT P combination to start the push back. Normally the aircraft will get pushed back 60 meters, turned RIGHT by 90° and pushed a further 30 meters before it will be stopped. There are airports that have pre-programmed push back paths from certain gates, and in these cases, the push back will follow the selected path and stop at the prescribed point. Once push back is finished, „SET BRAKE„ will appear in the communication window. Set the parking brake using the B key.

„It was a cold and snowy day when the push back truck started to push a DC-10 from the gate at Zurich airport. The 40 ton truck's tyres were slipping on the tarmac and only slow progress was made. When the engines of the aircraft were started however, the aircraft and truck came to a complete stop and would not move, tyres turning on the ice.... Now the Captain said „Wait, I'll help you!„ and engaged No 1 and 3 reversers in Idle. The effect was both immediate and scary. The DC 10 dragged the heavy truck along as if it was a toy on a string and started to turn violently to the right. It was only the quick reaction of this ground engineer who told the Captain to stow the reversers that prevented collision with a nearby parked 747. However, the turn now enabled the aircraft to taxi from this position so after disconnecting the truck, both truck and ground engineer made a hasty retreat from the scene... The aircraft continued to the runway, with marked sliding over the tarmac....„

Engine Start-up

Keystrokes involved: E 1,2,3,4 Start Engine 1,2,3,4,
O 1,2,3,4 Shut down Engine 1,2,3,4

AS2 engines feature automatic start up. So all you need to do is to engage the respective start switch and the engines will automatically start up, as long as there is fuel in the tanks.

Engine start up can be made either during or after push back. To start the engines, change to the secondary panel. Press the E 1 key to start No. 1 engine and watch the instruments. Once the engine is stabilised repeat the process with number 2 and any further engines. For the correct start up sequence please consult the checklist of the appropriate aircraft. With the B747-400, it is not recommended to start more than 2 engines before the push back has been completed, to avoid excessive strain on the nose gear, and possible damage.

„I will never forget the first start up I did as a ground engineer. It was a DC 8-63 belonging to a holiday charter company. It had diverted the night before to Zurich coming from Mombassa and now was scheduled for a short trip to Basle. On my signal Nr 3 engine started to come to life with a big howl. Once fuel was added, a huge flame engulfed the back of the engine, immediately followed by an equally appaling sight coming from the starter exhaust below. Behind me I saw the truck driver hastily leave his cabin and shout to me.... I signalled the crew to shut down and that there was sign of fire... They did that and the aircraft stayed on the ground for one more day while mechanics tried to figure out what went wrong. They found that a faulty ignition exciter had caused fuel to spill into the lower part of the engine, eventually igniting it with a bang much later than normal, causing the huge flame at the exhaust. From a leaky vane some fuel spread into the cowling where it also flashed off simultaneously.... what a way to start a new job....„

Things to watch out for during engine start are the rotations of both N1 and N2 RPM and EGT. Normally, once the start valve opens, you will see an increase of N2 first, followed by N1. Once fuel is added you will note a fuel flow indication followed by an increase in EGT. EGT has to stay within limits otherwise the engine has to be shut down immediately. The huge flames that sometimes shoot out of the tail pipe (which is referred to by some as „hot start„ and as „tail pipe fire„ by the others) are caused by residual fuel spilled in the engine due to poor ignition. The action there should be to shut off the fuel valve and continue cranking the engine to blow out the fuel inside. In the cockpit, a hot start is recognised by high EGT and sometimes accompanied by lack of acceleration. If EGT limits are exceeded during start up in AS2, immediately shut down the affected engine (e.g. O 2 if No 2 engine is affected) and try again after repairs. (ALT R).

Taxi

Keystrokes involved

SHIFT / (-)	Enable Nose Wheel Steering
<	Turn left
>	Turn right
L	Centre nose wheel

The steering features a nose wheel tiller to steer the aircraft on the ground while moving at low speeds. With Nose Wheel Steering enabled, the nose wheel will turn through the full range of around 80 degrees deflection to each side, while without it, it will only go to about 8 degrees. This implies that for tight turns you MUST use the nose wheel steering if you do not want to end up going off the tarmac into the grass or the lights. The indication for the enabled nose wheel steering can be found in the Control Position Indicator gauge. Watch the rudder indicator and apply SHIFT /. The rudder indicator will turn red, which indicates that the nose wheel steering system is now enabled. Press it again and it will return to yellow. Also note that it returns to normal mode if the speed exceeds 50 Kts, or if more than 50% power is applied.

Taxiway conditions now play a role in your technique, as the tarmacs and runways may be slippery because of ice, so caution is advised.

AS2 weather will influence the ground conditions. As a rule of the thumb you may expect the following conditions to be present:

With Overcast clouds in any layer and
Temperature above 4° C Rain, the runway will be wet.
Temperature between 0° C and +4°C Snow, Slush / Snow on the Runway
Temperature below 0° C Ice. Runway and Taxiways will be icy.

The nose wheel is quite a long distance away from the actual turning point of the aircraft which is located on the inner main gear. This implies that you will need to pay special attention to when to start a turn and how. As a further matter of attention you will need to consider that the nosegear only carries a limited amount of weight so it can easily start to slip or drag over the concrete if the taxi speeds are too high. Abrupt movements of the steering tiller will result in the same effect. The main technique is to gradually apply the nose wheel steering and to use full deflection only on very low speeds. The nose wheel will just slip over the ground and no change in direction will happen. If you experience this, slow down and release the steering, then reapply very slowly. This will take some practice before you get it right, especially on the 747-400. As a guide, do not use more than about 15 degrees of steering above 10 Kts groundspeed.

For normal joysticks with pedals, the nose wheel steering is activated with the SHIFT / (US/UK keyboard) or SHIFT - (German/Swiss keyboard) key combination. You will see the indicator for the rudder position turn red. Any application of power over 50% throttle position or excessive speed will deactivate this feature, it is also deactivated if an EPIC joystick driver is detected or when the aircraft is airborne. (for more information on EPIC, please refer to the EPIC section in the Annexes.)

Taxi speed.

As a rule, taxi speed should not exceed 20 knots. However, in a turn, particularly in a tight one, you want to be far slower than that. A 90° or 180° degree turn can only be done from a speed below 10 knots. Get the aircraft rolling slowly and then apply nose wheel steering to start the turn.

Use of Reverse Thrust.

The use of reverse thrust while taxying is generally prohibited.

First Steps and Exercises.

As a familiarisation exercise you should try to taxi the aircraft along a yellow taxi line on any airport in dry conditions. Use the nose wheel steering to turn left and right and try to follow the taxi line.

Find a intersection where a line crosses at a 90° angle and try to follow it. Stop the aircraft at about 45° and check the outside view. You will notice the aircraft standing somewhere cornered in the angle but not lined up properly on the line. Continue your turn until the aircraft has turned onto the 90° line and see again. While the nose wheel is now still on the taxi line, the main gear is not lined up at all but quite a bit left or right of the new line. Keep practising until you are happy with your performance.

- Using the outside view taxi straight until the 90° line is just before the wing. Switch back to Cockpit View and look out of the side windows until you can see the 90° line. Remember that perspective view!
- Now turn the tiller all the way into the direction of the line and start applying power until the plane moves. The nose will now turn rapidly around the inner main gear. Change the view to 45° and finally to forward when the 90° line appears again. Once you are centred on the 90° line, check with outside view again, your plane should now be perfectly lined up on the 90° line.
- Now try the same on a runway: First try a line up from a 90° Taxiway using the above method. Once you are comfortable with this, try a 180 ° turn on the runway, as used on a back track. That turn is done as follows:
  1. Taxi down the runway aligned with the centreline until reaching the numbers.
  2. Turn left towards the beginning of the outermost threshold mark and taxi towards it until you reach it with the nosegear.
  3. Turn right towards the 3rd lamp of the end lights and taxi about 10 meters towards it. The plane should now be aligned parallel to the centreline offset to the left.
  4. Now start a right turn with maximum nosegear deflection. The nose will first go towards the right edge line. In large airplanes that might cause the cockpit to be over the grass. Again, use outside view to compare the perspective you need to see from the flight deck. Keep turning that way until you see the centreline coming back into view.
- Try these exercises until you are totally comfortable with the taxi behaviour of the plane. As a final exercise use a docking system featured at many airports in the AS2 scenery the same way. If you manage to line up the plane correctly on a safe gate system and park it, that part of your training has been successfully completed.

All the above exercises should be first tried in dry conditions. Once you are comfortable with them, you can try wet and icy conditions.

Icy conditions

In icy conditions you will have several problems to face. First of all you cannot really count on any ground friction to speak of if the wheels skid. As a further factor, even at idle thrust, the engines still produce forces that might move the aircraft over an icy tarmac if the conditions are too bad. In that event, only a total shut down of the engines will stop the aircraft totally.

When steering the aircraft with the nose gear, on icy surfaces you will have to expect severe control problems. The nosegear can start to slip easily and therefore needs a lot of caution in taxiing. The only way to control this is by taxiing very slowly. Also brake in steps, don't simply slam down the brakes. If you own an EPIC and therefore have asymmetric thrust available, this might also help to control your direction.

Try for yourself by setting the appropriate weather and by taxiing on a wide and empty tarmac first, then gradually repeat the above exercises and familiarise yourself with the handling.

Flight Operation

Definition of Operating Speeds

The airspeed indicator in the cockpit does not show the real speed over ground, it shows an airspeed calculated from the pressure of the ambient air. So, for the sake of flight planning and performance calculations it is vital to define some terms and abbreviations regarding airspeeds.

IAS Indicated Air Speed

This is the speed shown on the air speed indicator in the cockpit. It is the speed the aircraft "feels" it is flying through the air, meaning the relevant speed to produce the same amount of lift at sealevel.

All Speeds which have to do with the aerodynamic operation of the aircraft are given in KNOTS IAS or KIAS. This includes all „V-Speeds„

TAS True Air Speed

This is the speed the aircraft is actually flying through the air. As the density of air decreases with altitude, the air cannot generate as much lift at the same speed as it could on sealevel. Therefore the aircraft needs to fly faster to produce sufficient lift again. At sea level, IAS and TAS obvisiously will be the same, at high altitude (low density) the IAS will be lower than the TAS. The table below shows the relation in approximation.

FL	SL	50	100	150	200	250	300	350	400
Factor	1.0	1.08	1.17	1.26	1.37	1.50	1.64	1.79	2.02

M MACH Number

This speed corresponds to a percentage of the speed of sound in the given conditions.

Mach 0.5 means that the aircraft is flying at half the speed of sound in that air, M1.0 means the aircraft is flying at the speed of sound in that air. Some limitations on the aircraft are given in Mach.

V Velocity

The V Speeds are a collection of speeds relevant to the aerodynamic operation of the aircraft. They are always given in KIAS.

VMC(A)(G) Minimum Control Speed (Air) (Ground)

The Minimum Control Speed for Airborne or Ground Operations determines the speed on which the full deflection of the rudder is sufficient to compensate for the loss of the critical engine. (see below for detailed explanation)

V1 Take Off Decision Speed

During take off it is vital to know the speed up to which you can safely abort and still stop on the runway. Before V1 this is the case, after V1 you have to continue a take off. (see below for detailed explanation)

Vr Rotation Speed

Rotation speed is the speed at which you can start to rotate the aircraft to climb attitude. (see below for detailed explanation)

V2 Take Off Safety Speed

The speed for the first segment climb. (see below for detailed explanation)

Vle Maximum Landing Gear Extended Speed
Vlo Maximum Landing Gear Operation Speed

Vne Never exceed Speed

Maximum Indicated Airspeed of an aircraft.

Mmo Maximum Mach Number

Maximum Mach Number of an aircraft.

V clean Minimum Clean Speed

Minimum Speed for flight without flaps.

Vref Threshold Reference Speed

Target speed for the landing. Should be reached over the threshold.

Takeoff

Take off is one of the most critical phases of the flight. The successful completion depends on several factors, such as runway length and slope, atmospheric pressure temperature and density, wind, take off weight and many more factors. The basic goal of the exercise is to determine a maximum permissible take off weight for a given runway.

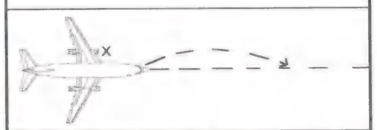
Take Off Speeds and Critical Limits.

In order to lift off the ground, the aircraft needs to achieve a minimum flying speed for the wings to generate sufficient lift. This in return requires a runway long enough to reach that speed with the thrust available. Now, what happens if a critical component fails during this acceleration phase? All this is covered in the following chapter, covering the take off limits in detail.

Minimum Control Speed (VMC)

In order to explain the significance of the Minimum Control Airspeed it is necessary to explore the effects of a power loss on one or more engines on a multi engine aircraft. If engine power is lost on one side, the aircraft will display a pronounced tendency to swing around its yaw axis into the dead engine. This tendency is countered by applying rudder and aileron into the operating engine in order to keep the aircraft flying straight. (The rule of the thumb there is „Dead Foot = Dead Engine, e.g. if you need to press your right pedal in order to maintain direction, then your left engine is out. It is quite a problem to identify the broken engine, and mostly you don't have the time. So: first fly the aircraft, counter the tendencies and then go ahead with analysis of the situation.)

VMCG



The left engine (X) fails suddenly. If VMCG is reached. the plane will be able to be steered back to the centreline with rudder input only.

However, in order to have enough aerodynamic force from the rudder it is necessary to have a certain speed, the Minimum Control Speed. This defined as the lowest speed at which the failure of the critical engine can be countered by the existing means of control, that is the rudder and/or nose wheel steering if on the ground.

If an engine failure occurs below that speed, lack of aerodynamic forces will not allow the aircraft to maintain a straight path, so it will, if no action is taken, immediately change direction. The only way to regain control is to reduce power on the operating engine to a level where control can be regained and to accelerate and avoid further loss of speed. Of course, on the ground, this would mean to bring the operating engine to idle and to abort the take off. In the air, this can be extremely dangerous, as if you find yourself in that situation only a few feet from the ground, the height available may not be sufficient to re-establish controlled flight before hitting the ground.

Therefore, the Minimum Control Speed represents the minimum speed where continuation of a take off in the event of a power failure may be considered.
VMCG is the lowest possible speed at which the aircraft can retain and maintain directional control by the rudder alone after an engine failure. It will be lower at high altitude and high OAT, as the thrust involved is smaller.

The Minimum Control Speed Airborne (VMCA) is the equivalent speed for airborne operation. It is based on the same principles as VMCG but additionally allows as an operating technique that the wing of the operating engine can be lowered by 5°.

For more information on flight with one or more engine(s) inoperative, please consult the respective chapter in the Non Normal procedures section of this manual.

V1 TAKE OFF DECISION SPEED.

This is the highest speed where the take off run can be aborted and the aircraft stopped without leaving the runway or stop area remaining.

V1 defines the speed during the take off run which is your final decision point to fly or not fly. Abort above V1 and you will stop in the potatoes.

V1 is influenced by many other parameters as well, such as the runway condition (slippery, wet or icy, which reduces it), wind and weather. It is not a fixed value, it has to be calculated for each departure, even when the departures are from the same runway at different times of the day, as there are too many variable factors in the calculation that change.

VR ROTATION SPEED.

It was on October 26, 1952 when the COMET 1 G-ALYZ taxied to its take off runway at Rome Ciampino airport bound for London. The weather was pretty wet and it was in the middle of the night when the captain started his take off run. As the speed rose the captain started to rotate the aircraft but instead of accelerating the aircraft failed to get airborne. When the crew eventually decided to abort the take off it was too late, the aircraft left the paved runway and was damaged beyond repair. Pilot error was blamed for the lack of any other ideas why that take off was unsuccessful. However, on March 3rd, 1953, the same thing happened to Canadian' Pacific's CF-CUN, another Comet 1, on its delivery flight, this time at Karachi.

Before the first jetliners, the importance of Vr was not recognised. However, 2 tragic accidents showed that the technique common at that time, to lift the nose wheel by feel and wait for the aircraft to lift off was not working with some jets, as the increased drag produced by the early rotation of the aircraft hindered its acceleration to flying speed. Therefore, Vr, the rotation speed was introduced. At Vr, the nose wheel is lifted off the ground while the aircraft is „rotated„ into climb attitude. The next vital speed to reach will be

V2 Take Off Safety Speed

V2 gives a margin over stall speed while also ensuring control in the event of an engine failure. Most airlines aim for V2 + 10 kts to V2 + 15 kts in the initial phase of the climb with all engines operating, to allow for speed loss to V2 in the event of an engine failure. This speed is maintained until Aa (Acceleration altitude) where acceleration is started for retraction of flaps and slats.

Take Off and Landing Distances.

When calculating the take off limitations for a modern airliner, you usually calculate the maximum take off weight for a given runway. This calculation has several steps.

Step 1: Runway limited Take Off Weight.

The distance required to get an aircraft airborne is based on the assumption that one engine fails at V1 and we need to be able to bring the aircraft to V2 at an altitude of 35' before the concrete below runs out. In practice this „Take off Distance„ leaves you with quite a margin in case of a normal take off, while it allows you to keep things together when one engine decides it's had enough. So as a rule, the first factor in calculating a take off run is the available take off distance (TODA) versus the weight of the aircraft, corrected by environmental factors.

Equally important in the calculation is the Accelerate Stop Distance Available (ASDA), which is the next factor considered in the calculation of the Runway limited Take Off Weight. The ASDA limit allows the aircraft to brake to a stop if an engine failure occurs at V1, using full braking effort only, no reverse thrust, (as it will probably be asymmetric in such a case).

The ASDA factor may be greatly enhanced if there is a stopway available after the actual runway, be it a displaced threshold on the far side or any other surface that will fully support the weight of the aircraft. In such a case the ASDA will increase the allowed take off weight for this factor.

The third factor in the calculation is the all engine take off distance multiplied by 1.15, which is a legislative requirement imposed on all public transport operators.

The minimum required runway length for a specific weight therefore is the longest of the three based factors of TODA, ASDA and All Engine Take Off Distance.

The Maximum Runway Limited Take Off Weight is therefore determined by the lowest of TODA, ASDA and All Engine Take Off Distance limited weight.

A major and variable correction factor on all the above figures is weather. In AS2 we have the ability to set the wind, weather and surface conditions. Wet and icy runway conditions can make life very interesting indeed.

Braking action is severely impaired by wet or icy runways where it becomes almost non existent. This significantly increases the required ASDA and therefore limits V1. While V1 can be reduced to VMCG but no further in order to accommodate this, any further reduction will be weight related. Therefore, a slippery or icy runway will effectively drastically reduce your take off weight or can prohibit a take off at all.

In the individual aircraft sections you will find the corresponding tables for the aircraft in question.

Step 2: Obstacle Limited Take Off Weight.

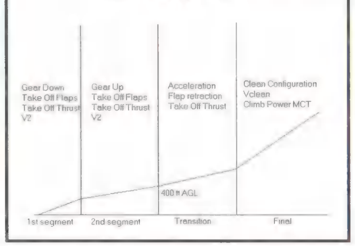
The second factor in determining a take off weight on a particular runway is the limitations implied by obstacles that are in the climb out path. While the runway may itself be long enough to accommodate a certain weight, obstacles in the departure path may intrude above the aircraft capability to climb in case of an engine failure.
Obstacle limited take off weights take into account any obstacle, that is situated in the departure path of the aircraft. The resulting net flight path must clear all obstacles by at least 35 ft with one engine inoperative.

In order to understand this limitation, we must introduce the so called Take Off Segments.

The Take Off Segments are defined as follows:

1st segment:	The initial climb from lift off until gear retraction.
2nd segment:	Climb to 400 ft AGL with Take Off Thrust and Flaps but Gear retracted. It is in this segment where the above rules apply.
Transition:	The acceleration with flaps retraction to climb speed.
Final:	Climb to cruising altitude with the clean aircraft and climb thrust.

Take Off Segments



Crosswind Take Off

If you have to take off in a crosswind you will observe some interesting effects. When preparing, check the aircraft crosswind limits, these must be observed. Then check your own skill limits. There are times when the wind simply becomes too strong to take off. Also, runway surface condition (wet or icy) drastically reduce the crosswind limits.

The first figure that needs to be found in a crosswind situation is the actual crosswind component. Any wind will produce several components on the actual direction, a crosswind component and a head- or tailwind component. To calculate your relevant head/tail wind component and the cross wind component, you can use the following table - calculate the difference of wind direction to your runway direction (difference=runway direction- wind direction), and disregard negative sign. If that result is less than 90, you have got a headwind, otherwise you'll have a tailwind, you then deduct the result from 180 and continue with that value.
Now look up the table with that resulting angle and your reported wind speed, and you can directly read your cross wind component. Using the table again with the value 90-your result you'll get the head- or tailwind component.

Crosswind Table

Speed	10°	20°	30°	40°	50°	60°	70°	80°	90°
5 kt	1	2	2	3	4	4	4	5	5
10 kt	2	3	5	6	7	8	9	9	10
15 kt	3	5	7	9	11	13	14	14	15
20 kt	3	7	10	13	15	17	18	19	20
25 kt	4	8	12	16	19	22	23	24	25
30 kt	5	10	15	19	23	26	28	29	30
35 kt	6	12	17	22	26	30	32	34	35

This table offers a quick solution to the crosswind calculation. While not totally correct to the last digit behind the comma, it is adequate for our purposes.

Example 1:
Runway direction: 35 (350° degrees)
Wind direction: 290°
Wind speed: 35 knots

Step one: Calculate difference of angles. 350° - 260 ° = 60 °
(If the resulting angle is bigger than 90° this indicates tailwind.)
Step two: Determine crosswind component 35 kt opposite 60° = 30 kt
Step three: Determine headwind component: 90° - 60° = 30° 30° opposite 35kt = 17 kt

Example 2:
Runway direction: 16 (160°)
Wind direction: 300°
Wind speed: 20 kt

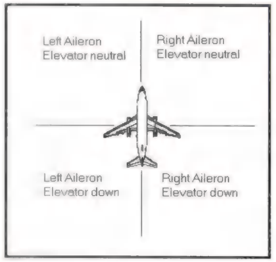
Step 1: 300° - 160° = 140° ! Tailwind!
reduce angle 180° - 140° = 40° Angle between wind and runway
Step 2: Crosswind component = 40° opposite 20 kt = 13 knots
Step 3: 90°-40° = 60° 60° opposite 20 kt = 17 knots TAILWIND

Wind on ground is always indicated in magnetic values, that means this calculation is sound. AS2 takes full advantage of this, as the surface winds are always relative to magnetic north, while winds aloft are relative to true north.

Wind limitations

While most flight simulators do not simulate ground winds, AS2 takes them fully into account. Wind components outside the defined limitations will result in unpredictable behaviour. For most aircraft of our category (MD80, B747) crosswind is limited to about 30 knots and tailwind to 10 knots. There is no limit given for headwind, as headwind will mostly shorten your take off / landing run rather than doing anything else. However, having said that: the only situation when a headwind indeed does become a problem on take off and landing would be if it approaches or exceeds Vs, as you might not be able to keep the aircraft stationary anymore. This is a huge problem for small aircraft but, hurricane conditions set aside, does not do us much harm normally. The cross and tailwind limits however mean you will have to make sure that you stay within wind limits for take off and landing, otherwise you might end up in the grass, (or worse) which is good for a golfer but not for a pilot!

Crosswind Take Off Techniques



During taxi and take off, accurate lateral control is essential in crosswind situations. Normally, in taxi no extreme problems will be experienced, but wind awareness is important.

At the beginning of the take off run, apply aileron into the wind direction and hold the elevator down firmly. While building speed, use rudder and nose wheel steering to maintain directional control. The rudder will become much more effective as speed builds. Keep the nose firmly down until reaching Vr, then rotate positively. Expect significant yaw into the wind as the nosegear lifts off and be ready to counter it with rudder input. Once the aircraft unsticks, and is safely clear of the ground, bank into the wind direction until a satisfactory crab angle has been established.

Practice is necessary to master these techniques so take your time around the training airport and try out these techniques with different wind speeds and directions.

Automation.

Flight Director

Introduction

A Flight Director System is the computational part of an automatic pilot. Its main purpose is to give accurate guidance information to the pilot in all phases of the flight.

The autoflight system provides automatic control of the ailerons and elevators in different flight modes, which can be selected on a operating panel. The autopilot takes the inputs of the sensors it is connected to, and calculates corrections which it then feeds to its servo motors which in turn move the flight controls accordingly.

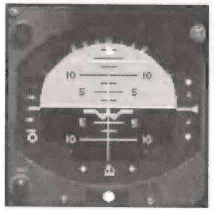
Lets take an easy example. If you fly level at 3000 ft and use an altitude hold mode, the autopilot takes its information from the altimeter and the pitch gyro. If the autopilot senses that the aircraft has descended below the commanded altitude, it will command its servos to pitch the aircraft up, so the altitude is regained. The same goes for the lateral functions: If you hold a certain heading with the autopilot, it will check the heading gyro reading and apply corrections when necessary.

It gets even more interesting when using a VOR or ILS as reference. Now, the autopilot, in NAV or APP mode, will determine the corrections necessary to hold a VOR radial or Localizer, and in the case of an ILS approach, the Glideslope. This will requires constant calculations, much as we have to mentally calculate how to keep the needles happy when we fly manually.

What a flight director system does, is display these calculated corrections on the Flight Director Indicator, which in our case, consists of 2 bars on the primary flight display or Attitude Direction Indicator. These will be a horizontal bar and a vertical bar. These bars are also referred to as „cross pointer„ bars. If the System senses a pitch up is required, it will raise the bar above the horizon to indicate the needed correction. If the AP system is engaged, the AP will then sense this command and follow it. It will raise the nose until the horizontal bar again aligns with the aircraft symbol in the centre of the instrument. If the system senses that we need to turn left or right, it calculates the appropriate bank angle and points its bar there. Again, if the AP system is engaged, it will bank the aircraft according to this correction until the bar is centred.

If the AP system is disengaged but the FD on, it is the job of the pilot to now follow the FD needles and keep them centred. That is relatively easy to do once you get the hang out of it. If the FD shows "Fly up", pull up until it realigns, and the same for turns. If it points right, bank right until the bar hits the centre again.

IMPORTANT: The key to understand a Flight Director is, that unlike a CDI or a VOR or ILS receiver, it commands a pitch and bank attitude to be followed in order to maintain or achieve the desired flight path.



Here we have a sample of a FD indicator, as used on the MD 83. The yellow bars show the correction suggested by the FD to regain the desired flight path. The Roll bar (the vertical one) is centred on this picture, suggesting that wings level is required to maintain the flight path. The Pitch Bar (the horizontal one) is at 14° nose up, telling the pilot that the FD wants him to pitch up significantly in order to archive the required flight path.

Flying the Flight Director is easy, the concept is to keep the needles centred. It is a good idea to first acquaint yourself with the FD by observing it while the autopilot is flying the aircraft. You will observe the corrections made and how the automatic pilot responds to them. Then disconnect the AP but keep the FD going and try it yourself. Remember, keep the needles centred - fly the aircraft to the intersection of the needles, and keep it there!

A good exercise is to fly a turn. Fly at 10000 ft and Heading 090 and engage HDG and ALT HOLD while on automatic pilot. You will see that the needles stay centred once the desired heading and altitude are reached. Now move the heading bug to the left to North. The vertical needle will move off centre to the left. When the aircraft starts banking to the left as well, the needle will gradually come back to the centre. Note, it won't be in centre when you reach your new heading but when you reach the bank angle required to do the turn. Now, as you bank, you will see that the horizontal line will also start to rise a bit, to counter for the descent tendency in the turn. The AP will need to lift the nose a bit to maintain the altitude. During the turn, the needles will stay centred, but when you approach the selected heading, the vertical bar will move right , commanding a roll out of the bank.. When the bank rate reduces, the horizontal bar will move down to maintain the altitude.

Now turn the AP off and try to follow this manually. First, fly North and try to keep the needles centred. Now turn the heading bug to the right, to 90° again. Follow the FD bars. Bank until the needle is in the centre, keep an eye on the horizontal bar and pitch accordingly. Stay on the needles and follow them. When approaching HDG 090, stay with the needles and roll the wings level as commanded, while keeping the horizontal needle centred as well.

Keep practising. Observe the FD in all phases of the flight and try to follow it manually. Your flying accuracy will improve accordingly. Remember: the FD commands pitch and bank, nothing else.

A final word: As with any Autopilot: If it does not do what you expect it to, don't trust it blindly but turn it off if you feel uncomfortable. Analyse the situation and try again. The FD is a machine, it is not intelligent. If you have selected a wrong mode, it will follow it. So you need to keep your mode management under control. If you run out of power, it can stall you while trying to maintain the altitude. Be careful, and don't forget the basics. With that in mind, the FD will give you a new perspective on IFR flying that you won't want to be without.

Level Change with Autopilot

Basically, the main implications of using the Flight Director have been outlined earlier. The same concepts apply to the use of the automatic flight control system. Set up the modes as required and already outlined and then engage the autopilot. The aircraft will now follow the flight director automatically.

The cautions regarding limits, particularly in vertical speed mode, are even more important. The automatic pilot will happily operate in the modes you have selected, but it is up to you to see that the limit speeds are not exceeded.

Automatic Thrust

Use of automatic thrust or Autothrottle will greatly simplify level changes. The autothrottle will control the thrust of the engines to achieve a particular engine power, e.g. Takeoff or climb, or they control the engines so that the aircraft flies at a particular speed (IAS or MACH).

Remember that power and pitch are used to together to control airspeed and vertical speed. Whichever function the aircraft is trying to control, you will have to control the other.

Speed select modes of an autothrottle system are used together with other modes of the Auto Flight Control system (AFCS), which will not revert to a given speed. They can be used with Vertical Speed mode, Altitude Hold mode or quite usefully with Approach (APP) mode. In all of these modes, the AFCS will lock onto either an altitude, a vertical speed or a glide slope of an ILS, adjusting pitch to keep it independent of speed. The auto thrust system will move the throttles in such a way as to maintain the speed on the basis of the commanded pitch.

The speed modes can be very hard to use in manual flight, and it should be avoided if possible. When trying to keep an altitude manually (or vertical speed / GS) it is a common technique to adjust pitch on a given power setting and then trim out the aircraft to stable flight. This obviously won't work here, as the auto thrust system will maintain the speed, therefore changing the power setting constantly. It is therefore of vital importance to be aware of the approximate pitch setting you want to expect for a given speed and configuration when using this mode. Trim the aircraft so that it follows this pitch and let the auto thrust system settle down. Only then apply corrections. Overcorrecting on this will create significant and uncomfortable oscillations in both pitch and speed.

For further information on the specific use of the Auto Thrust Systems in both aircraft, please refer to the autoflight section of the respective aircraft type.

Autopilot use

In cruise, the autopilot is used to reduce crew fatigue and to improve accuracy of flight. Most of the time in cruise, it is used in ALT Hold or VNAV mode (B744 only) on the vertical side, while it is used in either HDG select for manual following of airways, LNAV for automatic following of a pre-programmed route in the FMC, or VOR mode to follow a preselected VOR radial. Once again, see the respective aircraft section on how to use these modes.

Flight Management System.

NOMIS 2900a / 2900v FLIGHT MANAGEMENT COMPUTER

Introduction

The NOMIS 2900a / 2900v is a generic fully integrated Flight Management System. Its main functions are:

- Navigational Radio Tuning
- Performance Setting
- Route Planning and Display on ND EFIS Display
- Lateral Navigation Mode (LNAV)
- Full RNAV functions.

The NOMIS 2900v installed on the B747-400 also has Vertical Navigation capability (VNAV).

The control panel on the left is common to both the NOMIS 2900a and the 2900v variants. The following chapters will deal with the 2900v used on the B747-400, and we will mark in Italics the features that are not available on the 2900a system.

The FMC Control Panel has an alphanumeric keypad, a display screen and 12 line select keys. Only the left 6 line select buttons are presently in use.

The FMC is very easy to handle. Pressing the line select key to the left of the item you wish to select will select this item. The display screen will then either proceed to the next page featuring the selected item or will open the line for an entry. Entries can be made either using the FMC keypad with the mouse or using the normal PC keyboard. In order to access the FMC from the keyboard, you must be on the primary page so you can see the FMC displayed. All further commands require the SHIFT-CTRL key to be held. Holding those keys, the numeric and alphabetic keys on the main keyboard are used to enter figures in the FMC. The line select keys (LSK) on the left are keyed using the F1 to F6 keys (again with SHIFT - CTRL held.) LSK 6 has the same function in all pages, namely to return to the previous page. The ENTER key is represented on the PC keyboard by using (CTRL + SHIFT + ENTER).

Sample: To access the NAV option above press SHIFT - CTRL - F1 at the same time. The Navigation Radio Page will then be displayed. The display will call up different screens, or „pages„. The one you see on the previous picture is called the Index Page. It is the default menu page that is displayed when starting the program. All pages show the time set within the simulator software followed by the simulation rate. The picture above shows the time being 11:09 and the simulation rate 1x. From here by using the appropriate Line Select Key (LSK) you can proceed to the chosen page.

- NAV — Navigational Radio Page
- RTE — Flight Plan and Route Page
- VNV — Vertical Navigation Page
- VER — Version Page
- PRF — Performance Page

In the following subsections, all the functions of the FMC are described in detail. Please take your time to study it and practice the functions carefully. Once you have found out the basic functions, the FMC is very easy to use.

Navigational Radio Page

The Navigation Radio Page is accessed from the Main Index Page by selecting the NAV option using the line select key 1. It shows all Navigational Aids presently tuned in the navigation radios on your aircraft.

N 1	11:36:50/01x
N2	NAV1: MLG
ADF	115.70/ 000
	NAV2: LM
	110.50/ 315
	ADF: MLQ
RET	395

The page as displayed to the left here shows both VOR /ILS receivers with their tuned frequencies, the VOR / LOC idents and the selected radial. It also shows the ADF with its ident and frequency. The LSK's 1 to 3 are now used to access the tuning of the respective radios, LSK 1 for NAV 1, LSK 2 for NAV 2, and LSK 3 for the ADF. LSK 6 returns to the Index Page.

FRQ	11:36:50/01x
ID	NAV1: MLG
OBS	115.70/000
RET	VOR/DME

Pressing the LSK 1 will select the tuning page for NAV 1. You have the option of tuning the radio either by entering the frequency or the ident. To tune it by frequency press LSK1. The frequency display will turn yellow. Now enter the desired frequency using the keyboard as described above. (The 1 of the frequency will appear automatically so for 115.70 you only need to type 15.70). To finish the entry, press the ENTER key. To tune the radio by entering the ident, press LSK2 and enter the Ident on the keyboard. To enter the desired radial or localizer track, press LSK 3 and enter the desired OBS setting. Below the frequency and OBS line, a definition of what the tuned navaid is will be displayed. LSK 6 will return to the Navigation Radio Page. The page for NAV 2 is identical to the one for NAV1.

FRQ	11:36:50/01x
ID	ADF: MLQ
RET	395

The ADF tuning page is similar to the NAV tuning page apart from the OBS option which is not appropriate to the aid.

Version and Database Page.

This page shows the aircraft and engine type to be used for the FMC . Of course, these two options are not selectable. Below, with LSK5 you can select the database you wish to use for your flight.

11:36:50/01x
A/C B747-400
ENG RB211-254G
DB REGIONAT M
RET 1989-12-01

Normally, databases are loaded automatically with the scenery. However, if you have user databases you created for use with add on sceneries or atypical sceneries such as ATW, using this entry, you can manually override the database selection. Using the sample of ATW: If you select the ATW scenery in the scenery library you will not see any waypoints in the EFIS and the FMC will not accept any airports. To enable them, you select the ATW database manually via LSK5 and the following page.

11:36:50/01x
MAN DB ID: AT
AUT
REGIONAT M
1989-12-01
RET

Press LSK 1 for Manual. The option DB ID: appears with the current DB ident in yellow. Now overwrite the ident with the one you want to use. Below, the currently active database is shown.

If you want to go back to automatic selection, open this page again and press the LSK 2 key.

FMC database structure and selection.

The FMC databases consist of 2 files in the AS2 directory called REGIONxx.HSI and REGIONxx.FMS. The xx is replaced by a numeric or alphanumeric variable which indicated the database identification or ID. The commonly used databases are consistent with the use of co-ordinate systems, that means you will see the REGION05 files in use with Europe. However, if you have add-on sceneries like Switzerland installed on top of Europe, you might want to add the waypoints included there into the REGION05 database using SMSEDIT. Instead of overwriting the original, you may now choose to name the new region file differently, so you can select it manually. There are several region files for add-on sceneries delivered on the CD, REGIONAT is for ATP AROUND THE WORLD. Others will be available on CompuServe or on the NOMISSOFT website.

WARNING: THE MANUAL SELECTION OF A NEW DATABASE MAY ONLY BE DONE ON GROUND AND BEFORE PROGRAMMING A ROUTE. THE MANUAL SELECTION WILL AUTOMATICALLY ERASE A PROGRAMMED ROUTE!

Vertical Navigation (B747-400 only)

Vertical Navigation allows pre-programming of a vertical flight profile in the FMC, allowing more sophisticated automation of flight. The primary VNAV tasks as implemented in the NOMIS 2900v FMS are:

- Management of best power / speed / altitude profile for the entire flight path dependent on cost index and performance
- Implementation of different power modes for Take Off, Climb, Cruise and descent
- Implementation of derated power settings for Take Off based on assumed temperature.
- Information is provided on optimum flight level and speed as well as step climb options.

AIRLINE SIMULATOR 2

Main VNAV page

11:36:50/01x
PRF A.MOD: T/O
CLB EPR L: 1.71
CRU O. FL: 373
MCT O.SPD: .850
T/O D.STC: 250
RET T.STC:00:00

The main VNAV page is pictured to the left. It allows the user to activate different power settings manually or automatically and provides information on optimum flight level and speed.
LSK 1 (PRF) selects the VNAV Performance Page, which is explained below. The other LSK 2-5 manually select Climb, Cruise, Maximum Continuous, and Take Off Power mode in the VNAV page. Pressing any of those LSK's will cause the A MOD indication to change to the respective new mode and will adapt the EPR Limit indication below to the new setting.
The D.STC and T.STC information give distance and time for a step climb Step climb is required if the selected Cruising FL is higher than the aircraft can achieve at its present weight or configuration. You will need to proceed to an intermediate FL first and check the D.STC and T.STC display again for when to climb on. O.FL indicates the optimum flight level and O.SPD the optimum speed. Your flight level selection should be influenced by that value.

11:36:50/01x
SLT TAT : +14
ACH SEL : +14
SPD ACC.H :1500
CFL SPD : 157
CI CR.FL : 290
RET COST : 76

The VNAV Performance Page allows the setting of VNAV parameters for Take Off and flight. SLT selects an assumed temperature for take off. It can only be higher than the actual temperature. Engine performance will be derated according to the entered temperature.

The other LSK's allow you to enter ACH ,Acceleration Height above ground, where the autothrottle system will command Climb Power after take off and will also start flap retraction speeds. SPD allows to set manually the speed to hold. CFL sets CR.FL, the intended Cruise Flight Level. This value is used to calculate the step climb options.

The NOMIS2900v has an option of automatic step climb execution (ASCE). This option has been included to allow unattended vertical navigation for users who wish to do ultra long range operation while attending to their family or sleeping. To activate or deactivate the ASCE mode, select the CFL option on this page. Once you activate it, you will note the option AUT appear at LSK1. Press LSK1 and the letter A will appear in front of the cruising flight level. Now enter the cruising flight level using the keyboard. To deactivate the ASCE, simply select CFL again and press LSK1 again. The A disappears and the altitude authority will revert to the MCP again.

The programming team is aware that this is by no means a realistic feature as used in real life. However, the experience of many of our users flying ultra long range flights for many years using various simulators has prompted us to include this mode.

Cost index (CI/COST) ranges from 0 to 99 and modifies performance in a cost related way. CI 0 will give you a most economical but somewhat slower cruise setting of Mach 0.82, whereas CI 99 will set a cruise setting of Mach 0.86. (ATPUTIL's flight planner will always use cost index of 50 for its calculations).

Flight Plan

The Flight Plan section of the NOMIS 2900 FMS allows LNAV controlled flights between 2 destinations. It consists of several pages defining the departure and destination aerodromes and waypoints in between.

```
     11:36:50/01x
DEP
DST DEPARTURE
LEG LMML 32
PRO      DESTINATION
LGKL  35
RET
```

The Flight Plan Main Page is accessed via the RTE command on the Index page. It contains access keys for the Departure, Destination, Legs and Progress Pages of the FMC. This page also provides basic information on the departure and destination entered together with the selected runways for each airport.

```
     11:36:50/01x
APT
RWY      DEPARTURE:
LMML     32
         32  06  14  24
RET
```

The Departure Airport page is accessed via LSK1 on the Main page. It allows entry of Airport and cycling through the available runways.

Enter the Airport by pressing LSK 1 and typing its ICAO ident into the open field. The available runways appear. Now cycle through the runway using LSK2 until your desired departure runway is shown next to the identifier of the airport.

The selection of the runway has some significance. From the runway, a 2.5 NM long straight line is drawn to an imaginary waypoint called CLMB. This is a runway extension line which provides initial guidance for LNAV after departure.

```
     11:36:50/01x
APT
RWY      DESTINATION
N1       LSZH       16
N2       ILS:  IZH
         16  28  32  34
         10  14
RET
```

The Destination page is in most regards similar to the departure page. Also here the airport and runway may be entered via the LSK1 and 2. If the selected runway has an ILS, its identifier will pop up in the third text line. You can use LSK3 and 4 to tune that ILS onto NAV 1 or NAV 2 respectively.

Again, a runway extension is drawn to a waypoint called INCPT. It is situated approximately 10 NM from the runway on the extended centreline.

NOTE: Both Departure and Destination airport must be entered before any waypoint may be entered.

CAUTION: Changing Departure or Destination airport during flight will erase all waypoints in between.

```
     11:36:50/01x
DLA
NEW      ROUTE:
DEL      LMML-LSZH
DN       01.MLG
UP       02.CDC
RET
```

The legs page allows you to enter waypoints as part of a route. LSK 1 (DLA) will clear the whole route. NEW will enter a new waypoint at the line below the airports. DEL will delete the waypoint directly below the airports. DN and UP will scroll through the list of waypoints up and down the route.

How to enter and modify a route?

First enter departure and destination airport in the DEP and DST pages. You will note a line appearing on the Navigation Display, together with the CLMB waypoint. Then access the legs page. Press LSK2 to enter a new waypoint. Type in the waypoint followed by the EN key (or CTRL-SHIFT-ENTER). If the waypoint is in the database, the line disappears and the next waypoint number appears. (if this is the first waypoint an empty line with 02. should appear now.

Repeat that process until all the waypoints are entered.

Now use the UP and DN key to scroll though your waypoint list. If you have forgotten a waypoint, you can enter it by scrolling until the NEXT waypoint in the route is on the top line. Then press NEW. The waypoint previously on the top line will shift one position down and you can enter the forgotten waypoint.

In flight, if you wish to abbreviate the route and go direct to a waypoint before you, scroll the waypoint list until you see the active waypoint (the one you currently fly to) on the top line. Then press the LSK 3, DEL. The active waypoint disappears and the next waypoint becomes active. Repeat until the waypoint you want to fly to is on the top line.

Monitoring the flight progress.

```
     11:36:50/01x
ACT:      CLMB
          2.0/ 20
T.DIS:    416
ETA:      20:52
RET EFOB: 40
NX:       MLG
```

Once you have entered the route, access the Progress page from the Flight Plan Main page. (LSK 3 PRO). This is the most important page in flight. The page shows the ACTive waypoint. Below it, distance in NM and the track to it is shown. Below that, T.DIS shows the distance remaining to the destination. ETA is the expected time of arrival and EFOB the estimated fuel on board at the destination. (If EFOB shows 00 then something is wrong with your flight planning, better take more fuel or divert when already airborn!). NX shows the next waypoint after the active one.

Performance Page.
11:36:50/01x
P/L
P.LOAD: 35
FUEL: 30
TOTAL: 60
TAT: +14.5
RET V1 VR V2 118 125 135

The performance page is sort of an on line reference for weight and V-speeds. All you can enter on this page is the actual payload. (you can check and modify the payload in the F6 / 4 menu „Aircraft Loading„.
The page shows you a summary of Payload and Fuel on Board and the total gross weight of the aircraft. From this, it calculates the V-speeds for take off (when on ground) and for landing (when in the air). If the weight is above maximum Take Off weight or maximum Landing weight respectively, the whole page turns red. However, V-speeds are still calculated even in an overweight situation.

OK, that's the basic introduction to the aircraft's automation, it's time to try and make all this come together by flying the aircraft. We would suggest using the MD83 aircraft, at an airfield that you have some knowledge of, as long as the runway is a reasonable length, and has some instrument approach aids so that you can get some help from the automation at various stages of the flight.

Flying

Take Off Techniques.

Normally, take off is flown with the Auto Throttle and Flight Director on. Before take off, the V-Speed markers must be set to the correct values. Make sure the FMC Performance page is set properly by entering the correct payload onto the page. You can then read off the V-Speeds that get set automatically to V1, Vr and V2. Manually set the red bug to V2 kts, which will be the first target speed for the initial climb out. Heading bug must be set to the correct runway heading. Engage the FD in Take Off mode on both pitch channels.

Perform the take off checks as laid out in the specific aircraft section. (These include checks of the control surface movements, fuel quantity on board, speeds, autobrake setting etc.)

There are 2 types of take off technique: Standing Take Off or Rolling Take Off.

The Standing take off method has to be executed when any of the following conditions apply:
Actual TOW is close to MTOW or RTOW for the runway and obstacle
Visibility / RVR is low and close to the take off minimum
The runway is contaminated
There are icing conditions present

Line up the aircraft and stop it. Advance the throttles to about stand up position, which is about 1.4 EPR for the MD83, and wait for the engine power to stabilise at that value. Call out „Take Off„ and engage the Auto Throttle, then move the throttle to the maximum setting. *(This is an unfortunate requirement of the PC hardware, not a flying procedure, as there is no way in AS2 to move the physical throttle lever to match the Autothrottle setting, and if the physical throttle position is less than the desired Autothrottle setting, this can cause rapid hunting of the throttles within AS2)*

Verify that take off power is reached before 60 knots. Maintain the centre line using the rudders. Use slight forward pressure on the yoke until reaching Vr. The First Officer will call out 80 knots, V1 , Rotate (Vr), V2. When reaching Vr start a smooth and continuous rotation (using about 3 degrees per second) to take off attitude, which will be

between 12 and 20 degrees nose up, depending on weight. If you had to use rudder to maintain the centre line, the rudder now has to be centralised, while using the ailerons to achieve an offset heading that will now be flown to continue to track the extended centreline of the runway.
Rotating too early or too fast can cause a tail strike, so exercise caution. Do not start rotation before Vr. Accelerate to V2 + 10 Kts as soon as practicable.

Special attention needs to be paid to the nose wheel steering during take off. When the throttles are advanced beyond the 50% setting, the nose wheel steering becomes locked with the steering input deferred to the rudder. Also, nose wheel steering is progressively limited with power below 50% and speed below 60 knots. This changes the aspect of handling significantly compared with light aircraft which have nose wheel steering interconnected with the rudder input.

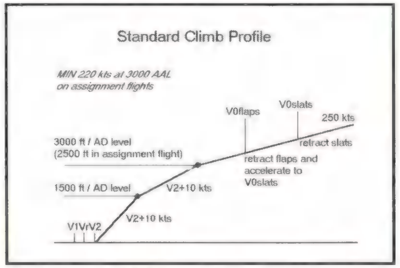
A Rolling take off can be performed when performance is not limited, and when the other conditions above are not a limit. In this case, the aircraft will have been cleared for take off before entering the runway (usually late in the taxi stage) and can transition from the taxi roll into the take off roll without stopping. All the pre take off checks must have been completed, and the throttles are "stood up" to part power as the aircraft is moving on to the runway, and as it becomes aligned with the runway heading, full power is then applied, and the take off continued.

Initial climb out

Once the aircraft has rotated and a positive climb rate is achieved, retract the landing gear and aim for a target speed of V2 + 10 kts, and climb to 1500 ft above the airport elevation with that speed and take off thrust. The FD should still be in take off mode, however, the speed indicator is the primary reference instrument. At 1500 ft select climb power. Keep V2 + 10 and climb thrust to 3000 ft AGL which is the default acceleration altitude (check the airport information or SIDs charts for other acceleration altitudes.) Above 3000 ft, you may start acceleration, and retract the flaps as necessary. Accelerate and maintain 250 kts below 10000 ft MSL.

NOTES:
When flying the B747-400, it is not possible to fly below 250 Kts at max gross weight and clean configuration, this has been allowed for in the simulation monitoring, and will not cause a derating in the career assignments

When flying career assignments, you must be flying faster than 220 kts IAS before passing through 3000 ft AGL. The original Assignment language was created before noise abatement procedures were introduced. Plan your acceleration to reach 220 kts at below 3000 ft , and also make sure you have 220 KIAS before contacting departure).



Hand flying the climb with or without Flight Director.

The use of Flight Director in all stages of the flight is highly recommended by most airlines as it contributes to the accuracy of the flight path. If engaged in IAS/MACH or Level Change Mode, the FD Pitch bar will command the optimum pitch to achieve the preselected speed with a given power setting. It is vital to make sure that during acceleration, when a new speed is selected in the IAS window, the rate of climb never becomes negative. This can happen if the IAS selected is higher than the aircraft can achieve with the power available in horizontal or climbing flight.

Use of Elevator Trim

When flying the aircraft by hand, trim becomes a very important tool to maintain airspeed. Power should be set as required. Note your actual airspeed. If the desired speed is higher, decrease the pitch slightly and observe the speed, repeat until you have acquired the proper speed. If the speed selected is lower, increase pitch gradually until the speed reaches the desired value. Once the desired speed has been acquired note the pitch angle and start trimming the elevator to relieve the pressure on the yoke. If you are holding up elevator, then nose up trim is needed, (Numeric 1), if nose down elevator is being held, then nose down trim is needed (Numeric 7) Use small increments of trim and release the yoke in equal steps until the aircraft maintains the noted pitch angle without any pressure applied to the yoke. If the yoke has to be moved further from the centre position, then the wrong trim is being applied. Check your speed again and change pitch as necessary to maintain it. Retrim if required until pitch and desired speed are steady, and no control yoke movement is being held. All of the above comments are assuming that your control yoke or joystick has a good centring system, if the spring return system is weak, or inaccurate in its centre positioning, it is going to be very hard to set the trim accurately. Another factor that may have to be reviewed when working with trimming is the null zone width in the Joystick settings option under Menu F6 .

If you change power, speed or configuration, retrim. Again find the pitch angle you wish the aircraft to maintain in order to keep a desired speed, then trim the elevator as described above.

This technique requires some practice, so try to fly as many exercises as possible until you feel it comes naturally to you. Correctly applied elevator trim is a vital step towards confident and successful IFR flight. It eases the workload dramatically and is a significant factor in achieving smooth and passenger friendly flying.

However, a caution Do not try to „fly„ the aircraft with the trim. This is a wrong technique and will result in unstable pitch flying. Use the technique described above and you will find your pitch control much improved.

Use of Automatic Flight Control System in the Initial Climb.

The use of the automatic pilot is usually encouraged above 500 ft AGL. As a rule the climb should be flown in Level Change (IAS/MACH) mode, with Climb EPR selected if available. This will guide the aircraft on the best speed / rate of climb profile. Vertical speed mode for climb is not recommended, as it disregards IAS totally. Use it for descent and approach purposes where it will give you very accurate and stable results.

Climb

Normal climb should be flown at speeds outlined in the AOM section of the respective aircraft.

Climb is best flown in Level Change mode of the Automatic Pilot. Set the desired climb speed in the IAS / Mach window. Advance power levers to climb thrust (or select it on the ATHR panel if applicable), the climb speed in the IAS window and preselect the new cleared altitude in the ALT window. Engaging LVL Change (or IAS) mode will adjust the pitch channel to hold the preselected IAS with the available power. If Autothrottle is used, in level change the ATHR will revert to either a predetermined climb power setting (B747)or to a preselected power setting selected by the thrust setting computer (MD83).

To fly a climb manually, it is advisable to do so using the flight director. With the AP off, use the LVL change or IAS mode and note the commanded pitch attitudes for different power settings. This way you can get a feel for of controlling your pitch attitude for a given airspeed. Fix the pitch attitude with constant throttle setting to the commanded value then use the elevator trim to eliminate the stick pressure. Be aware that you have to keep adjusting the throttles with increasing altitude to maintain a constant EPR / N1 setting.

A quite useful tool in level change is included in the EFIS cockpits. While you descend or climb, a green arc segment appears in the ND, showing you the precalculated location where you will intercept your target altitude. Using this tool, you can influence your descent so that you will „hit„ the new level where you require it. Also, you have an early indication if you will overshoot or undershoot a compulsory point.

Climb Profile

ATC restrictions apply in almost all countries to restrict climb speeds below FL 100 to a maximum of 250 KIAS, mainly to avoid conflicts with smaller and slower traffic. This restriction may be eased if traffic densities are light, or if the type cannot fly that speed in a clean configuration. Above FL100, you can use a higher climb speed, e.g. around 300 kts and, at higher altitudes, a constant Mach Number, around M 0.7. The idea is to maintain the Climb IAS until reaching the prescribed Mach Number, (the two will converge with altitude) and then to follow the mach number.

Flying turns

Flying turns with the new flight models is in many ways easier than on „conventional„ sim models. However, with reality come some of the effects missed before. Let's discuss the implications of flying turns a bit in order to bring you up to speed with which factors influence a turn.

Generally, while in flight, turns are flown by application of aileron into the direction of the turn. This causes the inboard wing to move down while forcing the outboard wing upwards. The resulting bank angle will divert the lift vector, which in level flight has been pointing upwards, into the direction of the turn. The aircraft will therefore leave its original flight path and turn into the direction of the bank.

As it does so, several counter forces are present. The lift vector pulling the aircraft in the direction of the bank creates increased gravitational loads on the airframe. Also, due to the fact that the lift vector is no longer pointing, the over all lift reduces. This needs to be compensated for by increasing the lift again, that means by applying elevator to counter the loss of lift. The loss of lift and the subsequent need to correct it with elevator become more and more pronounced with increasing bank angle.
Up to now, rudder has not been mentioned at all. Well, we have seen above that the most important elements in flying a turn seem to be co-ordinated aileron and elevator movement. However, there is a further factor in this. By applying aileron, the downward aileron will also increase drag on its wing . This causes the aircraft to be against the direction of the turn. In aerodynamic terms, this phenomenon is called „Adverse Yaw, and you counter adverse yaw with the rudder. On jet airliners, the design of the wings and the aircraft systems will do this for you. The effect of this is that the only time that the rudder is used on the larger aircraft is when yaw is needed (e.g. engine failure, cross wind takeoff and landing), , and those occasions are either on the ground, or very close to it, when there is a need to prevent wing tip strikes that would otherwise occur if roll were to be used.

G loads

How much G loads result from a turn? The actual G factor depends on the bank angle. With wings level, the G force points straight downwards. This results in the normal g factor of 1g, that means, any weight feels exactly as it would on the ground. Increasing the bank angle will cause this factor to rise slowly at first. At 30° bank, the factor is still quite negligible, about 1.2 g will be encountered. 45° of bank will give you about 1.5 g. At 60° of bank, 2 g are encountered, that means that any weight now weighs double as much as on the ground. From there, things get drastic rather quickly. At 75° bank, 4 g are encountered, at 80° bank you may count on 6 g. However, chances are that you will never get that far because the aircraft will call it quits long before that. The civil airliners of today are certified for maximum load factors of around 3.5 g. This implies that anything over 60° bank already goes into the no-no category. Also, passengers might complain if they all of a sudden feel twice as heavy. Most airlines limit the bank angle they want their pilots to use to about 30°.
Pitch attitude adjustments also produce G loads which can combine with the ones mentioned above. Any positive pitch change (nose up) will produce a positive G force, any negative pitch change (nose down) will produce a negative G force, (that is what produces flying tomato juices in the cabin) Flying passenger aircraft, smooth and regular pitch changes are therefore of considerable importance, as you don't want your passengers to use the air sickness bags.

Turn radius and airspeed.

Turn radius is a direct function of bank angle and speed. That is why you will see speed restrictions in turns on SIDs , where accurate ground track is of vital importance to ensure terrain clearance, or avoid conflict with the approach profile of another runway. Due to the limitations mentioned above, the only way for an airline pilot to really control his radius of turn is via speed. The general idea is that the higher the speed with a given bank angle, the larger the radius will be. Below is a table with some examples, TAS and bankangle providing a turn radius in meter/feet and the time to complete a 180 degrees turn.

TAS [knots]	Bankangle [degrees]	Radius [Meter]	Radius [feet]	180 turn time [seconds]
150	15	2273	7457	92
150	30	1055	3461	43
250	15	6316	20715	154
250	30	2931	9614	71
400	15	16168	53031	246
400	30	4332	14210	115
500	15	25262	82860	308
500	30	11724	38456	143

Stalling speeds in turns

The G loads in turns also increase the stalling speed quite dramatically. For a given Vs in level flight, the stalling speed will increase in by the load factor. As a rule of the thumb, at 30° bank the stalling speed will increase by 10%, at 45° bank by 20% and by 40% at 60° of bank. This also gives you some indications on the reasoning behind certain V-speed values we saw in the take off discussion. V2 gives you 1.2 Vs, making it possible to fly turns at all.

Yaw damper

Most jets today feature wings with a rather high sweep back angle to improve high speed performance. A swept back wing however has the distinct disadvantage that it produces an uneven distribution of lift in slips and turns. When such a wing is placed in a side slip condition, the windward wing will produce more lift than the leeward, thus leading to higher drag as well. As drag increases on one side of the aircraft, it causes a yaw motion. This yaw motion in returning brings the other wing into the wind and the whole cycle starts again. This is called „Dutch Roll„. It is not easily controlled by the pilot and can be very uncomfortable for the passengers. To counter this movement, a device called a „Yaw Damper„ has been installed in all jet aircraft featuring these wings to counter the yaw movements in turns. Flight with the Yaw Damper unserviceable is not recommended and may be subject to speed reduction.

Cruise

Choosing a Flight Level

Flight level selection is affected by several factors, some outside the control of the pilot. The most important factor in flight level selection today is economy. Most aircraft and engines operate most economically the higher they fly, so of course the aim is to go as high as possible. Having said that, it does not really make sense to go too high on short flights, because the time you spend high will be very short. In this situation, you might end up using more fuel to climb to the „economical„ level than if you had burnt less fuel climbing to an „uneconomical„ that is lower level and stayed there for the shorter duration.

The trick in such cases is to settle for a practical compromise on a flight level which will not burn tons of fuel to get there, yet if still offers reasonable economy. Of course, the aircraft manufacturers have taken care of this and provide you with tables which will allow you to choose your flight level according to distance and time flown. They can be found in the respective aircraft sections. However, a very basic thing to know about in using these tables is:

Equivalent Still Air Distance, ESAD (Also known as Nautical Air Miles NAM)

You will regularly encounter find this factor used in cruise tables, so here is an introduction to what it means. ESAD is short for Equivalent Still Air Distance. This has to do with wind influence.

If you are flying in absolute calm weather, your speed over the ground will be identical to your true air speed. Add some wind, and this will no longer be true. The wind will either slow or accelerate your groundspeed, getting you to your destination faster or slower, depending on the wind component. At the end you will end up with a flight time that differs quite a bit from the one you would have ended up with in still air. In that flight time, you will have been flying through moving air, so the ESAD gives you the difference between the miles travelled over the ground, and the miles flown in the air.

The formula for ESAD is:

$$\text{ESAD} = \text{Ground distance (N miles) X} \frac{\text{TAS}}{\text{TAS (Kts) +- Wind component}}$$

(+ for tailwind, - for headwind)

Sample: Assume a ground distance of 1000 NM, a TAS of 500 kts and a headwind of 50 knots.

ESAD will therefore be:

$$\frac{1000 \text{ NM X } 500}{500 - 50} = 1000 \text{ NM x } 1.111 \text{ kts} = 1111 \text{ NM}$$

This result means, to reach a destination 1000 NM away with a 50 knots headwind will use the same time and fuel as reaching a destination 1111 NM away with still air.

ESAD is widely used for flight planning purposes, especially for calculating fuel requirements.. Refer to this chapter please when prompted for ESAD in the aircraft chapters.

Descent

Descent is usually flown with idle or minimum power, and airspeed as the main reference. As outlined before in the chapter „Level Change„ this implies use of the respective modes, that is Level Change in the B744 and IAS in the MD83. In both cases, set the airspeed to the defined value for descent and then engage the respective mode. The main difference between the Level Change mode and IAS mode is, that while the autothrottle will reduce thrust on the B744, it will revert to „clamp„ mode in the MD83, which means you have to set descent power manually. In general this means something close to flight idle.

Flying the descent manually has the same implication: retard the throttles to idle and maintain the prescribed descent speed in the respective aircraft section. The best way to manage this is to trim the aircraft thoroughly as you establish the descent speed.

A alternative way to fly a descent is to fly it with constant vertical speed. The appropriate mode is available in both MD83 and B744. Again, enter the new altitude and the vertical speed you want the aircraft to follow. Airspeed will then be controlled by the autothrottle. You need to be aware that there is a limit to this; once the throttles are on idle and your rate of descent will let speed increase over the desired speed, you will either need to deploy spoilers or to reduce the vertical speed. Also use caution when approaching the limit speeds! As speed is controlled by throttles only, no speed protection exists as in IAS / LVL Change mode.

Descent Profile

The descent profile is the opposite of the climb profile outlined above. You descend from high levels to FL 100 with a prescribed speed, usually around 300 knots again. Before reaching FL 100, you will be expected to reduce to 250 KIAS in order to observe the limit. In some cases, approach procedures will have a speed restriction point marked on them, at which the aircraft will have to have reduced speed, regardless of Flight Level. This means, that you have to start decelerating well before reaching the limit point or FL 100, by levelling off or using spoilers until your speed has decreased to 250 KIAS before continuing to descend.

Planning your descent.

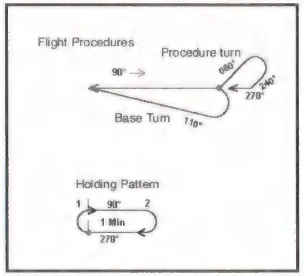
Planning the descent is quite important if you don't want to be too high or too low too early. Refer to the tables for „time fuel and distance to descend„ and plan your Top of Descent (TOD) well ahead. Once in descent, in the EFIS cockpits you actually get a visual clue on the exact location you will hit your target altitude. This is very useful, as you can vary this point a bit by changing the rate of descent or by reducing speed.

Final Approach

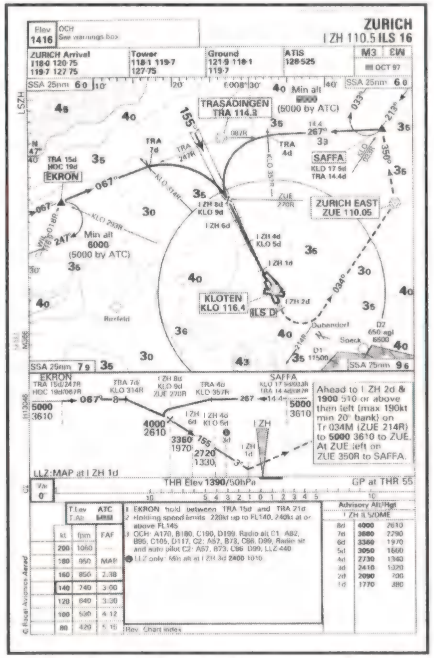
On October 17th 1982, a Boeing 707 was approaching Geneva Switzerland with a full load of passengers and crew. The commander, a veteran Captain with more than 12000 flying hours, was handling pilot of the aircraft, which was running behind schedule. 83 NM before the beacon of St. Prex, the aircraft started its descent from FL390. The Captain decided to execute a „high speed approach„. By the time he had reached 18 NM from the field, the controller became concerned as the aircraft was very high and still travelling at over 320 knots. The ILS was intercepted 10 NM out slightly below the glide slope but still at a speed of 320 KIAS. Flaps were still retracted. The co-pilot challenged the Captains decision to extend the gear at 270 kts as speed was above the limits, to which the Captain replied that in Emergency they could lower it at 320 kts. This happened at 4.5 NM shortly before the marker. The aircraft crossed the Outer Marker 540 ft above the glideslope, 105 knots too fast and with a sink rate of 2500 fpm. Flaps were still up, gear down, engines idle. In order to get the speed down, spoilers were employed. The flaps never reached the landing position. Less than 30 seconds before the touch down, the Captain inquired about the missed approach procedure. 10 seconds later, the engineer called for the speedbrakes to be retracted. The Middle Marker was passed 250 ft high, with a speed of 36 kts above Vref and engines in idle, the sinkrate was over 2000 fpm. 5 seconds before touch down, the GPWS started its „Pull Up„ routine. The Captain applied take off power but shortly afterwards, the aircraft touched 35m before the runway in the grass, at 146 knots, 20 kts too fast. 400 m after the start of the runway, the aircraft left the runway to the left, turned 245°, damaging the landing gear and tore off a wing, which bent 90° forward, and started to burn immediately. The crew of a Swissair jet, ready to depart at the holding point, watched in horror, as the aircraft smashed its way and urgently called the tower „Hello, tower, did you see that crash here?„ to which the tower replied „Yes, everything is moving now, please taxi back to the ramp....„. With sheer unbelievable luck, nobody was seriously injured in the evacuation. The whole crew still fly, only the aircraft is now on „display„ at the Geneva Airport fire station, next to a DC7 which does look much better...

The Approach segment of the flight is probably the most demanding of all. During approach, all previously mentioned skills and flying techniques are needed to be at the right spot at the right time with the right speed and configuration.

The approach itself begins with the arrival segment, which usually consists of either a Standard Arrival Route (STAR) or a route segment to the Initial approach fix. During the arrival, altitude and speed are reduced to meet the required altitude over the Initial Approach Fix.
The initial approach starts at the so called „Initial Approach Fix„ or IAF, from where the prescribed approach track begins. Usually, this part of the approach sets the aircraft up for the intermediate and final approach phase. This involves navigational manoeuvring to follow the prescribed track, and speed and configuration changes to be ready for the lower final approach speed when required. ATC separation requirements also can influence this stage of the flight. The intermediate approach may involve a hold, and it ends with the aircraft on the correct path to intercept the final approach path.



The top sample shows the plan of a Procedure Turn course reversal on top and a Base Turn course reversal below. The procedure turn is flown from a navaid or intersection or from a track as a base. In the sample, the aircraft would be heading east first to the starting point. It would then turn off track by 30° , that is a heading of 060° and follow it for 1 minute, then turn outward to the opposite heading of 240° until intercepting the inbound track of 270°. The base turn is flown on a fixed heading from the starting point, here 110° to a time limit or intersection (which also can be a DME position) and is then lead back to the inbound track with a turn opposite its starting turn. In the above example, the aircraft leaves the station on a heading of 110°, (with a right turn off the outbound track of 90°), so, after reaching the end of the base outbound leg, a left turn is required to come back to the inbound track of 270°.



A holding pattern is used if there is a need to delay the final approach time. The standard form of hold is shown above. A holding pattern is always based on a fixed point. The inbound track points to the fix point and here the track is 270°. After overflying the fix, a standard rate turn to the reciprocal heading with is made . When reaching the „abeam„ position (1) a time check is made. The outbound leg is normally defined by a time limit (here 1 minute) or by a DME distance. The aircraft is turned back onto the inbound track after completing the outbound leg. If there is any wind blowing, the times and headings flown may have to be significantly varied in order to maintain the hold.

Most Instrument Approaches feature these procedures in one way or the other, so it is useful to familiarise yourself with them. While you will find that AS2 is not yet capable of automatically flying holding patterns, you can and should use holds and course reversals in other flights such as online sessions or if you are practising IFR approach procedures. Also, while on assignment flights, after having been cleared for approach, you are generally free to execute any manoeuvre that will line you up properly with the approach path. These procedures will allow you to do this. Using the procedures outlined here will help you to complete the flight to your satisfaction. If you are flying into an airport that does not have any ATC services available, but has published approach procedures, it will be much simpler to get on to the ground if you are able to follow the methods outlined here.

Let's now look at a sample approach chart for Zurich, Switzerland. This is the sort of detail you would expect to see for any of the precision approaches that you will use with AS2, and it based on the information details or "plates" that are used every day by the professional world for flying. It has a lot of detail on the one plate, and this plate is only one page of a whole section relating to Zurich airport, and in the real world. you may use as more than 8 different pages during the course of a flight into and back out or Zurich. There's no way that we can provide that many plates for each airport in AS2, so you have representative pages that will allow you to operate in and out of the main centres that are most important.

Those of you who fly real aircraft will probably recognise the approach plates that we have provided here.

All the Enroute and airfield approach charts included with Airline Simulator 2 are reproduced with the permission of RACAL Avionics Aerad, whose assistance is most gratefully acknowledged. As the information shown on aeronautical charts is subject to constant change it must be stressed that **these charts are strictly for use with Airline Simulator 2 and must on no account be used for real-world navigation or operational purposes.**

Taking this approach chart as a sample, it is pretty much what you will see on most approaches. The Entry points to the procedures on this chart are either EKRON or SAFFA, depending on which direction you are approaching from. After these points, you follow the prescribed flight track until a DME distance, D7TRA from EKRON or D4TRA from SAFFA, and then turn towards the localizer to give a standard 30° intercept heading until established on the localiser centreline.

Altitude wise, you will leave both EKRON or SAFFA at 5000 ft, stay there until overflying the DME marks and then descend to 4000ft before reaching the Final approach Fix at 8DME fix on the LOC. From there you would hold 4000 ft until intercepting the glidepath and then descend on it until reaching the minimum decision altitude.

From a piloting point of view, the approach requires careful preparation if it is to lead to a successful landing. . The aircraft needs to be navigated, configured and flown at the proper speed, height and position all the time. For the simulator pilot, the workload is considerably higher, as you also have to deal with ATC, and carry out all the actions such as deploying flaps and landing gear which would normally be the responsibility of the non flying crew member.

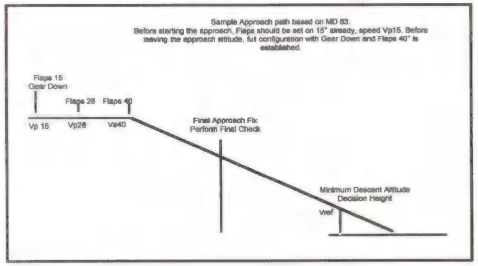
Approach Configurations and Speeds

The Approach needs to be flown using specific airspeeds with the appropriate configurations to match. The first stage in any approach profile will be to lower slats, followed by flaps and landing gear at a predetermined moment.

If you have not flown a large transport aircraft simulation before, there are several points to be made here. In order to make a good landing, the approach must be stabilised at least 4 miles before the runway, so that no significant changes of speed, attitude, configuration or power should be needed or made during the final approach. In order for the approach to be stable, significant power will be being produced by the engines, and this is normal, and part of the safety procedures, and this reduces the time needed to make a missed approach, the time taken to spool engines back up to go around power is too long if they are running at flight idle setting.

The general procedure is to configure the aircraft in such a way that before starting the final descent (normally at about 4 miles from the runway) the aircraft is in full landing configuration. In practice, that means that you will need to leave the initial approach fix ready to start configuring the aircraft. Slow the aircraft down to the minimum clean speed. Extend the slats and slow to min slats speed. Extend Flaps to the first stage and reduce speed accordingly. If the type has several stages of flap, you will need to deploy these and reduce speed accordingly. Once on the

inbound track, before reaching the descent point, extend the landing gear and, after slowing down to the correct speed, landing flaps. (this most often happens as the Glideslope becomes active, but before the point of commencing the descent, and if timed right, the extra drag of the landing gear and flaps will start the descent on the approach profiles without significant power changes). After leaving the approach altitude for the final descent, fly the appropriate speed for the respective flap setting until reaching Vref.



This graphic shows the individual steps for the approach.

As mentioned before, the key to success in keeping speeds and altitudes again is pitch / power control. Stabilise your speed using pitch and trim inputs and control the descent rate using power. The descent rate on a standard 3° glideslope will vary between 500 fpm and 800 fpm, depending on airspeed. The AERAD charts have a handy table for each approach which defines the correct descent rate on each approach.

The Minimum decision altitude MDA or Minimum decision height MDH is based on standard ICAO recommendations and depends on a variety of factors. The first one is the kind of approach in use. An ILS can have as low a DH as 20 ft in CAT IIIa conditions. A normal CAT I ILS will have 200 ft AGL, CAT II would be at 100 ft. A non precision approach usually has minimum descent altitudes of around 400 ft AGL. Obstacles in the approach or overshoot path may raise these minima considerably At Sion, Switzerland, the ILS minimum descent altitude is for this reason at about 4000 ft AGL, that ILS being a rather steep 6° glideslope one only designed to get the aircraft below the cloud cover.

If you are on an ILS approach, you need to immediately commence a go around if you reach the minimum and do not have the runway in sight. If you are on a non precision approach however, you have to note the location of the so called Missed Approach Point, or MAP. This point defines where the actual missed approach starts. The procedure would be to level off at the MDA and fly on the approach track to the MAP. If there is no contact over the MAP, you then go around.

Now that we have discussed the vertical part of the approach, let's have a look at the navigational part. Up until intercepting the final approach track, navigation is pretty straight forward, following your prescribed flight track until intercepting the runway. This changes though, once you are established on the localizer or final approach track. First of all, the localiser needle is much more sensitive than on any VOR, resulting in often overestimated control movements. Keep your heading corrections to within 5° on the approach in order not to over control the approach line. In no wind conditions that means that once you are established on a localizer of, say, 140° direction, your heading corrections should stay within 135° to 145°. Bank limits should be at about 5° as well. You will find that if you correct in this way, you will have less problems keeping the localizer set.

The same applies to a VOR or NDB track you might follow, only be aware that it takes more to deflect the needle there. That also implies that you need to correct on a trend already, rather than waiting for a real deflection to develop.

Approach briefing

Before beginning any instrument approach, you should familiarise yourself with the approach procedure. Make sure you have got the correct chart on the top of the pile, calculate all your landing and approach speeds and verify all navaids you need for your approach. Then remind yourself of the approach procedure. You may follow the scheme below, or make up your own, but make sure you include everything.

- Location and kind of approach: ILS 16 Approach to Zurich Switzerland.
- Approach Configuration: Configuration, Flaps 40, V speeds: Vp0, Vref.
- Initial Approach Altitude: Initial Approach Altitude 5000 ft at Ekron/Saffa
- Approach Track: Approach Track, 156°
- Approach Path: From Ekron, 067 track to DME7 TRA, right turn to Intercept heading 111 until localizer, descending to 4000 ft. Intercept latest at DME8 IZH.
- Minimum Descent Altitude MDA 1590 ft QNH, 200ft QFE.
- Missed Approach: Climb straight ahead to DME2 IZH or 1900ft or above, turn LEFT, intercept track 034° of ZUE. Climb to 5000 ft QNH and proceed to ZUE, then turn left to SAFFA and hold.

By briefing like this, you will not miss anything important and you should then be ahead of your aircraft.

Autopilot use

The AFCS can be very helpful on the approach, both on a precision approach and a non precision approach. Both the MD83/88 and the B747 are fully autoland certified, that means that you can actually use the automatics until roll out in any certified ILS approach. However, a fundamental requirement for the successful use of the AFCS in the approach and landing phase is an intimate knowledge of how to use it and which modes to employ for which scenarios.

In the initial and intermediate approach, you will probably find HDG select and ALT HOLD / LVL CHANGE a good choice of modes to employ. Follow the radar vectors to the airport and use the Altitude Preselector and the LVL CHNG to descend to your assigned altitudes. In the level segments, use the autothrottle system to keep to the approach speeds, while observing the speed restrictions for most airports. AS2 in particular wants to see correct approach speeds, and pays close attention to staying under 250 kts below FL 100. As we discussed before, aim to reduce speed well in advance and if at all possible in level flight.

Once cleared for the final approach, the mode to use will be determined by which kind of approach you are flying. For an ILS you will use ILS or APP mode, depending if the ILS is CAT III autoland certified or not. If the ILS is autoland certified, you can use the system until landing. If not, you need to disconnect the Autopilot when reaching the MDA or at the latest at 200 ft.

If it is a non precision VOR approach, use NAV or VOR mode for the lateral navigation and ALT HOLD / VS for the vertical profile. It is here where VS mode comes to good use; most approach charts will give you a rate of descent vs. airspeed table which will provide good adherence to the prescribed glidepath.

A word of caution regarding use of LNAV in the intermediate or final approach: Experience shows that it is highly advisable not to use LNAV after turning onto the final intercept heading. The main problem is that the LNAV is not accurate enough to keep an approach profile. Disconnect LNAV when on the final interception heading and fly using HDG SEL and arm APP mode. Unlike LNAV, which will try to fly the intercept itself, this will force the ILS capture as soon as the localizer is active. LNAV may not get you close enough to the LOC to allow an acceptable capture at the correct point and time.

Once you are established on an ILS or have attained your MDA on a non precision approach, it is a good idea to preselect the Missed Approach Altitude on your Altitude window, in case you need to perform a go around, as all you need to do then is arm ALT capture and let the autopilot do the rest.

AIRLINE SIMULATOR 2

Flare, Touchdown and Landing Run

When passing the final approach fix, in most cases the outer marker, it is time to make a final check of all systems for landing. In particular, pay close attention to landing gear and flaps. It is of vital importance to have the gear extended of course, but also missing a step of flaps or forgetting to arm the spoilers can ruin your day. Repeat the landing minima and be aware of the go around procedure, something that should be briefed well in advance. Fly exact approach speed and maintain localizer and glideslope with small corrections. When reaching the minimum descent altitude, reduce speed to Vref.

At about 50 ft start to flare the aircraft by slightly increasing the pitch while also smoothly reducing power. By 20 ft the power levers should be retarded fully. Maintain your slightly increased pitch angle until the main gear touches down, using rudder and ailerons as needed to maintain the centreline tracking. Verify spin up of the wheels and automatic deployment of the spoilers, land the nose wheel carefully and select reverse thrust. Use the rudder more positively as the speed decreases , and in a strong cross wind, apply aileron in to wind. In normal cases, the autobraking system and idle reverse will be sufficient to stop the aircraft, but if you need to stop quickly, apply more reverse power, up to maximum allowed. Upon reaching 60 knots, cancel the reverse thrust in order to avoid compressor stalls. Activate the nose wheel steering and maintain the centreline using small control inputs.

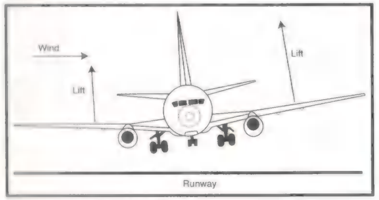
If at any stage of the final approach you have the slightest doubt about the successful completion of the approach and landing, perform a missed approach.

Crabbing, slipping

The moment wind is introduced in the scenario, it needs to be taken into account as it will be possibly be pushing you off the approach path, and may also be affecting your ground speed. You should already have some information about the weather from the pre flight briefing, and The ATIS should confirm the surface winds and the landing runway, so you have some idea what to expect.

In the EFIS cockpit of the 747-400 and the MD88, a very nice feature allows you to determine your wind correction angle automatically. On the navigation display, a green arrow shows the actual ground track you are following on the top of the display. If there is wind, this arrow will move away from the centre. All you need to do is to keep the green arrow on the approach track and use it as a reference instead of the heading line. This makes the determination of the wind correction angle (WCA) very much easier.

Align



Of course you cannot possibly land with a significant crab angle and expect to stay on the runway. So, you need to „kick out the crab angle„ at about 200 ft above the runway. This is best done by applying rudder and aileron at the same time to turn into the runway axis . Of course, the moment you do that, the wind will blow you off the axis, so you must do something else to compensate for this. The most common technique is to fly a wing low approach, which means keeping the windward wing a bit lower than the other in order to archive lift towards the wind direction, as shown here.

Once the aircraft is on ground in such conditions, it is vital to get sufficient weight onto the nosegear while the rudder is still effective in order to avoid a weathercocking effect. As the wind blows on the huge surface of the vertical tail, it will press it into its direction and will therefore turn the aircraft towards the wind. Lower the nosegear gently but firmly onto the ground and apply forward pressure on the yoke to keep it there. Extend spoilers and apply full braking as soon as practicable in the landing run, along with reverse power. Once the speed has dropped below 60 knots, cancel the reversers and continue braking until at a safe speed to leave the runway.

Landing
We have already discussed the touch down techniques further up. What we did not discuss are the landing run and implications of contaminated runways and abnormal conditions.

Like the take off distances, the landing distances available need to fulfil certain criteria. In the performance parts of the different aircraft, you will find tables that allow you to calculate a maximum weight for a given landing runway. Taken into account in this calculation are several factors. First, landing distance available for the chosen runway is determined from the airport chart. A safety factor of 1.6 is added to it, to allow for all sorts of mishaps. In theory, for any landing you perform, you should have 1/3 of the runway still in front of you once you stop. If you end up with steaming hot brakes and the runway end below you, or ploughing somebody's fields, you have done something wrong.

Runway Conditions
You will find that the allowable landing weight reduces quite drastically if the runway is contaminated in any way. The main problem with contaminated runways is, that any deposit, be it water, slush or ice, reduces tyre friction. Tyre friction however, is the most important thing for maintaining directional control and braking action. Thus, a contaminated runway will increase your stopping distance dramatically and will reduce your crosswind landing limit.

Basically, landings on icy runways should be avoided if at all possible. If you are forced to land on such a surface, make sure that you do so with the utmost caution. Crosswind is usually limited to around 5 kts for such conditions. You will also see snow appear on your windscreen when AS2 simulates these conditions, so watch out. Make a normal approach and landing. After touch down, immediately deploy spoilers and reversers and use as required. Use brakes with caution.

Anytime you see rain on your windshield, you must consider the runway as wet. A wet runway has the possibility of aquaplaning so again, use the brakes carefully and only when below aquaplaning speed.

To find out on the effect of icy or contaminated conditions, please refer to the aircraft flight manual section of the respective aircraft.

Use of reverse thrust.
Reverse thrust is a very effective way of braking an aircraft. It has one major drawback which is noise. Many airports restrict the use of reverse thrust, so do pay attention to the airport charts. Of course, in AS2, you can make all the noise that you want...

Reverse thrust should not be used when below 60 knots because of the danger of compressor stalls. The reflected air gets sucked in by the engine intakes and create a turbulent condition there. So cancel reverse when going through 60 knots.

If you are operating with one engine out, try to use symmetric reverse only. That means, on the 747-400 you may use any 2 operating engines on opposite sides, on the MD 83, you should try to avoid using more than minimum reverse thrust. The problem with asymmetric reverse is that it will pull the aircraft quite violently to one side. That means, that you could well end up in the mud instead of the runway.

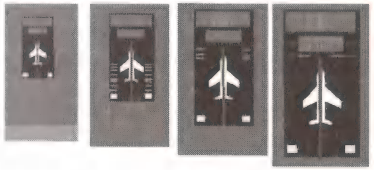
Go Around
Going around is something that many pilots think does permanent damage to their reputation. Many accidents have happened that way. If an approach does not look right, you should not hesitate to give yourself a second chance, it is much better to do that than to crash and be dead for the rest of your life...

Once the decision has been taken, there is no time to loose. As a first step, immediately apply go around thrust. If you are on Autothrottles, simply press the TOGA button. This will automatically set the calculated go around thrust. As soon as thrust starts to build up, raise the nose in order to keep V2. Flaps should be raised to take off position as well. If you have the gear extended, wait for a positive rate of climb, then select the gear up. From there on, proceed as if you just had taken off, and continue to fly a normal climb profile.

If a go around becomes necessary at the end of a CAT II or CAT III ILS approach, ground contact may occur. While undesirable, it is abnormal and should not be a reason for concern. If you make ground contact, do NOT discontinue the go around, but keep going. If the slats deploy, immediately retract them. If the autobrakes activate, give a kick on the brakes to release them. Normally, ground contact on a go around happens in bad visibility and you don't want to end up speeding down a runway without seeing anything. Once V2 is attained, proceed with a normal go around and climb procedures.

Taxi to the gate and shut down.
Taxiing to the gate is quite the same challenge as taxiing from it. Again exercise caution and taxi slowly in order to avoid loss of control.

At most gates at the international airports, you will find a docking system called „Safegate„. What safegate does is to guide you along the gate line to the parking stand.



The graphic shows the different indications of the safegate system in action. On the first picture to the left, the aircraft is approaching the gate but has not yet been acquired by the safegate system. On picture 2 the nose wheel is following the ground sensors. The green lights show the position on the sensor path. The blue vertical line is the left/right guidance which makes sure you follow the yellow taxi line below. On the third picture, the aircraft is approaching the correct stopping position. The indicators turn yellow and „Stop Short„ appears in the window above. If you now taxi on very carefully, the next indication is shown on picture 4. „OK„ appears in the upper window, „STOP„ in the lower window and the position indicators turn red. If you taxi too far, „TOO FAR„ appears in the top window.

Summary
This concludes the Normal procedures section of the flight school part of this manual. Please read it carefully and follow the guidelines in order to get the most out of your Simulator. The next section covers the Non Normal procedures that are used in the event of a failure, which requires different operating techniques.

Non Normal procedures.

Ground Handling.

Icy conditions
In icy conditions you will have several problems to face. First of all you cannot really count on any ground friction to speak of if the wheels skid. As a further factor, even at idle thrust, the engines still produce forces that might move the aircraft over an icy tarmac if the conditions are too bad. In that event, only a total shut down of the engines will stop the aircraft totally.

When steering the aircraft with the nose gear, on icy surfaces you will have to expect severe control problems. The nosegear can start to slip easily and therefore needs a lot of caution in taxiing. The only way to control this is by taxiing very slowly. Also brake in steps, don't simply slam down the brakes. If you own an EPIC and therefore have assymetric thrust available, this might also help to control your direction.

Try for yourself by setting the appropriate weather and by taxiing on a wide and empty tarmac first, then gradually repeat the above exercises and familiarise yourself with the handling.

Flight Operation

Engine Failures during Take Off and during flight.

Engine failure in the take off phase is one of the most serious scenarios for any pilot. In order to be ready for it, regular detailed practice in the simulator is a requirement for professional pilots and exact adherence to procedures is fundamental.

As described in the section about Vmc, the essential task in the case of an engine failure is maintaining the intended direction of the flight. If the engine fails below V1, the take off is aborted. Braking the aircraft in this case occurs with brakes and spoilers only to avoid the yawing effect by using asymmetric reverse thrust..

Determining the operating engine.

Determining the operating engine is one of the most difficult things in one engine out operation. In the take off phase there is almost no time to do a thorough analysis. The best way to work when the engines are producing high thrust is to analyse the situation from a control force point of view. An inoperative engine will require pedal pressure to be put towards the operating engine to retain direction. That rule is probably the most important one in multi engine flying:

The foot you use to press the pedal is on the side of the operating engine.

The „dead„ foot is on the side of the „dead„ engine.

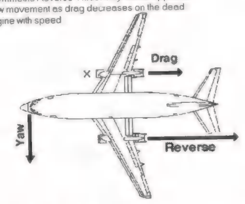
After this immediate consideration. other forms of analysis may be considered, time permitting,. Engine indications are not necessarily immediate indicators of a failed engine. N1 and N2 for instance may take a long time to wind down to a level where analysis is possible. EGT may not decrease fast enough to determine anything. Fuel flow may decrease but depending on the cause of defect, not fast enough. EPR however is a sure indicator, as the pressure within the engine really will change instantly in the event of a failure.

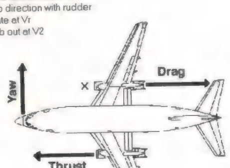
Different Engine Out Scenarios and their handling

Now let's look at failures during the different phases of the take off and their implications. Engine Failure before V1

In the event of an engine failure before V1, take off is aborted. Using reverse here can be tricky, as the graphic shows. Accelerate-stop distances do not allow reverse to be used at all. On a 4 engine aircraft such as the B747, reverse on the symmetric engines may be used quite effectively without creating much hazard, whereas in a twin jet, things look different. The main action on aborting such a take off would be to close both throttles, apply full brakes, extend spoilers to increase drag and only then to consider reverse if applicable.

Engine Failure before V1.





Engine Failure after V1

The main concern with an engine failure after V1 is to maintain directional control. Keep the aircraft on the runway by applying rudder against the yawing tendency. Keep the nosegear firmly on the ground until reaching Vr, then rotate normally. On attaining V2, maintain it to Aa. Retract the gear as soon as positive rate of climb is achieved. At Aa, set Maximum Continuous Power on the operating engine. Maintain V2 to 3000 ft before accelerating to flap retraction speed. No action should be taken on the inoperative engine before 1500 ft. Only then, after determining the inoperative engine, it may be throttled back and shut down.

One Engine Out Climb

In the event of an engine failure at take off, the climb profile shown earlier is still valid, but it may be necessary to allow the speed to drop back to V2 if necessary, in order to achieve the maximum angle of climb over obstacles.

Engine failure in cruise.

Unlike an engine failure in the take off and climb phase, engine failures in the cruise are much less dramatic. While they also require prompt and appropriate action, response time may be considerably longer than on a failure during take off and initial climb.

Over the years, many different philosophies on how to deal with engine failures in flight have been discussed and used. One which seems to prevail is to assess the situation following a simple guideline of PPA, standing for Power, Performance, Action.

First task, Power: determine which engine(s) are delivering power and adjust if necessary. This may mean advancing the throttle levers to Max Continuous Power on all engines , then reducing them one by one until the inoperative engine has been determined. Crosscheck your findings with the instruments.

During all this, never forget the golden rule. **Aviate, Navigate, Communicate.** Keep the aircraft in the air, and under control. If this is not done, the rest is academic. Then, make sure it's going in a safe direction, so that it can stay in the air. Only when these are certain, tell someone on the ground that there's a problem.

One of the most controversial discussions of recent years has been the correct use of automation systems during the analysis and resolution of a problem. Older captains have tended to increase their workload by switching off all the automatics at the first sign of a problem, and hand flying the aircraft while attempting to also resolve the problem. The newer generation of pilots have been encouraged to use any system that is working to reduce their workload so that they can concentrate more on the problem resolution. Both concepts have their merits and shortcomings. You must decide which is best for you, remembering that all of the aircraft in this simulation are normally flown by at least a 2 man crew, and you only have a virtual first officer who will not be able to help you diagnose the problem.

Second task, Performance: Determine a power setting for the operating engine(s) to keep the flight path as required. This can mean Max Continuous Power but it may mean considerably less power, particularly if you are in a descent or have to start a descent as the consequence of the engine failure. Determine if a drift down is applicable. If so, review it and set navigation accordingly.

Third task, Action: Once the flight path and power setting has been organised, it is time to assess the damage. Why has the engine failed? Can it be restarted? If so, is it reliable or do you need a diversion anyway?

In AS2, our means of restarting an engine in flight are quite simple. In the respective AOM section, you will find a restart envelope for each engine type. That envelope will say e.g. that you need to be below a certain altitude and within a predefined speed range. The procedure for restart in this case would be to attain this envelope conditions and then restart the engine using the E key followed by the number of the affected engine. CAUTION: Please make sure you select the correct engine number! Pressing the wrong one will shut down the selected engine, and the silence is very penetrating!

Flaps failure, slats failure, over stressed wings (asymmetric lift)

During flaps retraction you have to make sure the flaps and slats retract equally on both sides. If they fail to do so, the lift generated by the wings becomes asymmetrical. This is a potentially very dangerous situation, and if the airframe is over stressed by exceeding the flap limit speeds, this simulation will produce these effects.

An American Airlines DC10 took off from Chicago O'Hare Airport some years ago. During Rotation, one engine fell off the wing. This damaged the hydraulic links which kept the flaps and slats in place. Unknown to the crew, the slats on the damaged left hand side retracted. The Crew flew the aircraft according to the checklist for one engine out. Initially, they climbed away at around 180 knots which was enough to keep both wings above the stall speed. However, when , they reduced speed by increasing the pitch to come back to V2, which, as we saw earlier, needs flaps and slats, the left wing stalled while the right wing still produced lift. The aircraft subsequently turned on its back and began pitching down violently and finally struck a mobile home park. It was totally destroyed upon impact and all on board perished.

In an equally unsettling event, a Boeing 727 experienced an uncommanded extension of only one segment of slats on one wing while in cruise at 31000 ft. The result was frightening to say the least: The aircraft turned on its back and went into a spin. Only when the slat broke off, some 20000 ft lower, were the crew able to recover the aircraft, which is believed to have exceeded Mach 1 during its uncontrolled descent.

The AS2 simulation can produce Asymmetric flap or slat conditions if the limit speed for the flap or slat is exceeded, so pay careful attention to the speeds when these devices are in use. Be very careful not to deploy slats or flaps too early in the approach at too high a speed, as this will almost certainly lead to problems later in the approach!

How can you recognise such a condition? Well, let's review what happens in such a case. Flaps or slats extending asymmetrically will cause the wing on which they are extended more to produce more lift, therefore starting a bank movement. That means, if the aircraft starts a unexpected bank movement, first of all immediately counter it with ailerons. Check for engine indications, if all engines are operating normally, asymmetry becomes likely, particularly if the unexpected bank starts after moving slats or flaps. In such an event, as a next step reset the flaps lever to its previous position. Observe the effect. If no improvement can be noted, leave the flaps lever in its present position and trim the aircraft along the roll axis. Land immediately.

Approach and Landing One Engine Inoperative Procedure

The performance of most aircraft means that an engine out approach and landing is no longer the performance issue it used to be, but it does require some attention on the piloting side. Lets explore for a moment the implications of an engine inoperative approach and landing.

As we have discussed in previous chapters, a failed engine requires control inputs in order to maintain heading and flightpath. The amount of control input required depends strongly on the amount of power produced by the operating engine, the higher the thrust setting, the more control input is required. In cruise flight, it is possible to adjust aileron and rudder trims to trim out all the control forces. Trim works very nicely here, as power input is more or less constant. With any power change however, it is necessary to correct the trim settings again.

In the approach phase this presents a problem. If you look at the normal profile of an approach, you will notice that considerable power changes are required in order to maintain altitude or a glide path, the most significant power change occurring during flare and touch down, when the power is reduced to idle. It is therefore quite impractical to use rudder and aileron trim in this situation as, in the worst case, you may not be able to counter the effects of a deflected rudder quickly enough and you might lose directional control altogether. It is for this reason that aileron and rudder trim must be returned to their neutral positions before starting the final approach.

Considering the above, you will realise that flying the approach will require extra control forces, as you will manually need to keep the controls deflected to counter the asymmetry. As we said before, the more thrust is produced the more control input is required. It is therefore a logical consequence that you would try to minimise the effort by not using excessive power settings if avoidable. To fly with low power settings however, requires to keep the aircraft in a low drag configuration for as long as possible. As a rule, we recommend using the standard approach profile, but use a lower flap setting and delay extending the high lift devices by one stage. Taking the MD83 as an example, you would try to use flaps 28 for landing rather than using flaps 40 and would deploy flaps and gear only when starting descent on the glide slope. The aim of this whole exercise is to keep the aircraft flying in the direction needed and also to keep it flying until a safe landing can be achieved. The reduction of drag on approach will facilitate this, and help significantly in the event of a go around. Every effort should be made to avoid having to make a single engine go-around, especially if there is high ground or other obstructions in the departure profile. If, in addition, there are problems with reduced visibility, a short runway, or significant cross wind, serious consideration should be given to diverting to a more suitable airfield. Fortunately, the normal joysticks or control yokes in use on a PC do not require high physical strength to operate them, so physical fatigue is one issue that will not arise on the simulation.

On short final, you will need considerable control inputs to keep the aircraft steady and stable, as you will then be in the worst drag/power configuration, with Flaps and gear extended and low speed. One rather important item to remember is that you need to immediately change your control inputs, on the rudder in particular, once you retard the remaining thrust levers for touch down. Be prepared for this on your first approaches with one engine inoperative; as you retard the thrust levers, at the same time reduce the rudder from the live engine side to prevent a strong yawing motion.

Keeping these facts in mind, flying an approach with one engine out can be anticlimactic. Don't expect problems and you won't have them, but maintain a clear plan of the required flight path, and act positively to regain it if things start to slip.

Abnormal approaches (no flaps, no slats, partial gear, asymmetric lift)

Whenever an abnormal condition exists involving either secondary flight controls or gear problems, things do tend to get interesting. Approaches with partial flaps or slats for instance require a much higher approach speed than normal approaches. This in turn calls for much longer runways, as there is much more speed to lose after landing. If you are faced with a scenario where for some reason you have neither flaps nor slats, you will look at approach speeds exceeding 200 kts.

Be well aware that arriving with this kind of speed, you will put even the longest runways to good use. If you have a flap / slat problem, consider diverting to a large airfield with a wide and large runway with favourable wind conditions, and no terrain restrictions on the approach profile, as you may not be able to fly the normal approach profile, and you will be flying a fast ("hot") landing. On finals, fly strictly Vref for the slat / flap setting in use. Don't try to flare but rather fly the aircraft to the runway and make a positive arrival. Immediately on touch down, deploy spoilers and full reverse, and use maximum safe braking until reaching taxi speed.

Go around with an inoperative engine

Going around with an inoperative engine is something you should avoid, but one day, you might have to do it. This is where you will appreciate what has been said during discussion of one engine inoperative landing. Configuration should be with a reduced flap setting. All that we said about the normal go around applies, but you have to act much faster. First, apply maximum take off thrust. Counter the yaw effect with the rudder and aileron. Immediately reduce flaps to take off setting. Maintain V2. Once you have a positive rate, select the gear up. Thereafter, continue as you would on a OEI climb out.

If an engine fails in the go around, the same principles apply. However, you might have full landing flaps extended. Most aircraft will not climb or even hold altitude with full flaps and one engine inoperative. So it is imperative to reduce the flap setting to take off flaps immediately.

Keeping the Dream Alive; Part 2

There are few people like the one responsible for the development of Airline Simulator 2. Simon Hradecky is a very special person to everyone who knows him or his products. To the latter, he tends to break into existing conventions and stun everyone around with his amazing work. To the former, well, let's say few share the privilidge of being able to work with such a person. He is the only person I know that ever called the classic language of Latin „easy„. He is also the only one I know who would set about the task you see the results of before you single handed.

Few people who have experienced Simon in a „real world„ simulator, ranging from Boeing 737's to 747's and from DC9's to Concorde, could have anticipated the unique flying talent of a man who holds no pilot license and has to date only had few hours of real „stick„ time. Once, in a MD83 Simulator, I „forgot„ to tell the instructor that Simon had no real life flying experience. The question, in the middle of the lesson, „which airline you said he was flying for?„ tells a lot. That day, we drove some virtual inhabitants of the virtual Hong Kong below us definitely out of their minds, with visual and instrument circuits on the world's most demanding airport, Kai Tak. Few real MD83 pilots would have anticipated the aircraft being flown to such an interesting and challenging program. In the 747 I recall some wall panels that fell off during a full stall exercise, something the simulator could simply not handle due to its flight model.

If a programmer and pilot like that sets out to redefine the word „flight model„, the goal can only be a perfect reproduction of the flying qualities of the portrayed aircraft. Stopping short would not be an option. I recall some reactions to the first beta models, one by a simulator instructor from a major British airline exclaiming „my full flight sim can't do that!„ to a side slip demonstration, and much later a German B737 captain who discovered how to fly the product in front of you by stating „I have to fly it like an aeroplane, not like a simulator, then it will work fine!„ and going on to fly a perfect approach and landing to his homebase at Innsbruck.

The new simulator had it's first public debut at Interstate 8 at Krefeld, where the AS team won against a strong competition with room to spare, a performance repeated a year later at Bolognia. It was a fine moment for all of us that took part to see Simon carry the trophy home!

What you have before you is the result of thousands of hours of investigating and partly rewriting the aerodynamic principles taught in flying schools today, and also of a most unusual co-operation of highly dedicated designers, pilots and consultants from real world aviation. This team worked hard concentrate on features that really matter to make the simulation a „flight simulation„ and paid a lot of attention to details that are relevant in real world aviation as well.

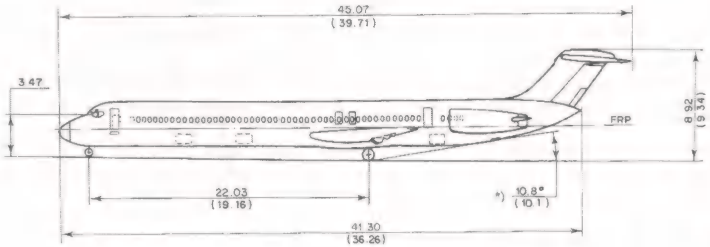
Aircraft Flight Manual MD 83

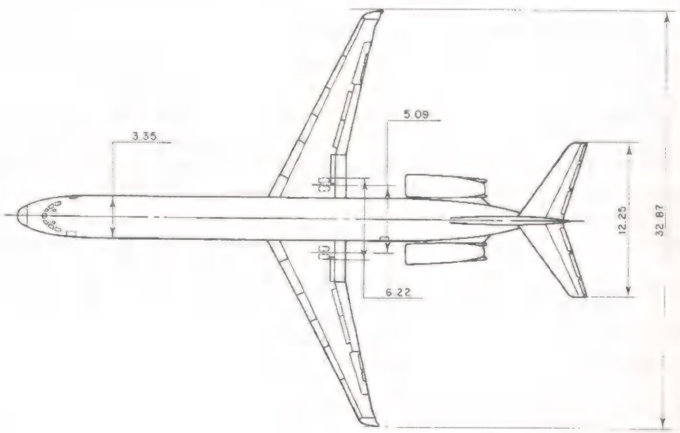
Aircraft Description and General Information

The MD-83 (DC9-Series 83) is a short to medium range commercial aircraft, certificated in the transport category. The aircraft is powered by 2 tail mounted Pratt & Whitney JT8D turbofan engines.

With the required equipment installed and operative, the aircraft can operate to Category 3a limits.

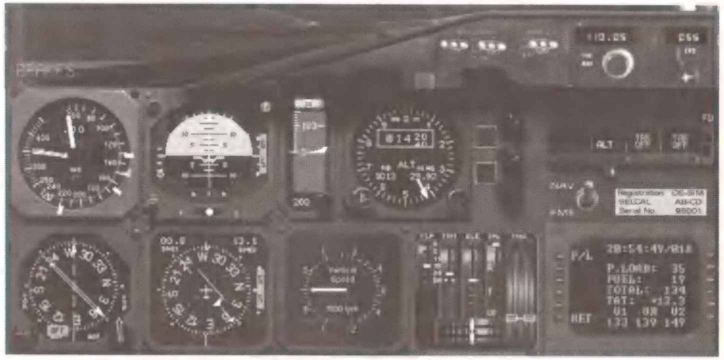
Dimensions





Cockpit Arrangements

The Cockpit arrangement is a standard 2 crew environment. Flight instruments are presented in a T cluster in front of each pilot.



The engine instruments are installed on the centre panel between the pilots.

Weight and Loading

Gross Weights

The aircraft must be operated within the specified weight and balance limits shown below.

For permissible take off weight limits with regard to performance limitations check in the performance part of this manual.

Aircraft	DOW	MZFW	MTOW	MLW	MRW
MD83/88	80'000	122'000	160'000	139'000	161'000

Balance Limits
The aircraft must be flown within prescribed balance limits. In real life, a complex calculation must be performed when the payload and fuel weights are known in order to arrive at the correct balance, and the aircraft has to be loaded to ensure that the balance is within the permitted limits.

In AS2, we would be over complicating things by going to this level, so the centre of gravity is arranged to automatically follow a predetermined schedule based on the weight curve. This will give you an aircraft which is in balance throughout the flight. The balance cannot be modified by the user.

The centre of gravity moves with added weight. This is set to represent the effect of loading passengers and freight as well as different levels of fuelling.

Flight Controls
The primary controls include Ailerons, Elevators and Rudders. The secondary controls include Flight and Ground Spoilers, Flaps, Leading Edge Slats and the Horizontal stabiliser.

Primary Flight Controls.
The primary flight controls are connected to the control column and rudder pedals. They work in a conventional way. The aileron system is cable connected to the control column wheels. The elevator system is connected to an aerodynamic boost system that operates a single control tab on each elevator. Each control tab is driven by a two way cable system and connected to the control column. The rudder is normally operated hydraulically, but has a manual backup system involving a control tab which is directly connected to the rudder pedals.

Secondary flight controls.

Ground and Flight Spoilers
The ground and flight spoilers provider aerodynamic braking in the air and on the ground. Each wing has two flight spoilers which are operative during all phases of flight and one ground spoiler which only opens on the ground.

The spoilers are operated from the cockpit by means of a control lever. To extend the spoilers, press the INSERT key on the numeric keyboard, to retract them, press the DELETE key. The spoiler position is indicated on the multi function display. The spoiler control has 4 positions: Down, Armed, Flight and Ground.

In the Down position, all spoilers are retracted.

In the Armed position, spoilers will extend automatically after landing, when wheel spin up on the main gear occurs. or with the nose gear on the ground.

In the FLIGHT Position, spoilers will extend to the in flight speed brake position. This will provide braking in the air. In the GROUND position, ground and flight spoilers will extend, slowing the aircraft on ground.

In addition to the manual and armed spoiler extension modes, flight spoilers are also used to improve aileron effect in bank. If the control wheel is turned in excess of 5°, flight spoilers extend fractionally on the downgoing wing.

The spoilers will deploy automatically during a rejected take off when the reversers are applied.

Flaps and Slats systems.
Flaps and slats are provided to improve low speed handling of the aircraft.

There are 6 leading edge slat segments mounted on each wing. They are controlled by the flap/slat control lever in the cockpit, (keys + and - on the numeric keypad) and can be operated automatically by the stall-warning system and auto slat system.

The slat position indicator light is on the centre panel. It gives following indications:

TAKE OFF	Slats extended and flap setting < 26°
DISAGREE	Slats are extended but do not match the position of the flaps lever.
LAND	Slats are extended and flap setting > 26°.

The flaps are controlled by the same as the slats. There are 6 non adjustable positions: 0°, S, 11°, 15°, 28°, DOWN.

In the 0° position, slats and flaps are retracted.

With S selected, the slats will extend to mid position and indicate TAKE OFF on the annunciator. Flaps remain at 0°.

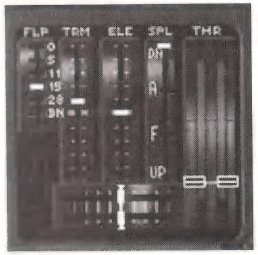
At the 11° position, flaps will extend to 11° while slats remain in the middle position.

At 15°, 28° and Down, the slats will move to the fully extended position while the flaps will extend to the selected setting.

Warning system
Both slats and flaps systems are protected from excessive aerodynamic loads by warnings, and there are also warnings of inappropriate configurations.

A „Slat Overspeed „ warning will sound if slats are extended when above 280 kts. The warning „Slats„ will sound if the throttles are advanced to take off position while on the ground with the slats retracted. The same principle applies the „FLAPS„ warning which will activate on the ground if the throttle is advanced and the flaps are not in the take off position. If the flaps are extended by more than 20° and the landing gear is up, a „LANDING GEAR„ warning will sound in the cockpit.

Indicator systems.



Primary and secondary flight controls are shown on the multifunction gauge on the left. The left pointer shows the position of the slat/flap lever. Next to it, the stabiliser trim position can be seen.

To its right, the elevator position is shown, next to it the position of the speedbrake/spoiler lever. On the bottom of the scale is a double gauge showing aileron deflection (upper scale) and rudder deflection (lower scale). The lower scale will turn red to show nose gear steering mode when selected.

On the right, the position of the throttle levers are indicated. The throttles on this picture are in the ground idle position. They will move towards the top of the picture when thrust is applied and towards the bottom of the picture if reverse thrust is applied.

On top of the aileron and below the rudder bars, the small bar is the related trim position indicators. They show the relevant position of the trim surfaces for rudder and aileron trim.

The slat position indicator is placed on the centre panel.. It can show the position of the slats in retracted (dark), take off or landing position. If the slat position does not match the position of the Flap lever, a disagree light will illuminate.

The flaps position is indicated with a dual pointer indicator on the centre panel. Normally, the two needles match and show left and right flap position. Should an asymmetry occur, the indicators would show it.

Automatic Functions on the MD 83 Flight Controls.

The MD-83 will deploy the spoilers to ground position when reverse thrust is activated, regardless of whether or not spoilers have been armed. The autobrakes will also activate at the same time. Both actions provide automatic assistance during a rejected takeoffs.

If the spoilers have been armed, the spoilers will fully deploy to ground position when any of the main or nose wheels spin up, and the autobrakes will also be activated.

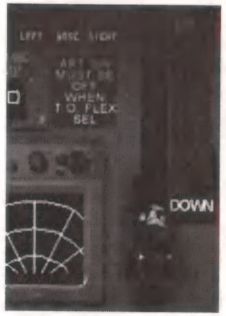
Note that without spoilers armed and without reversers opened, the autobrake system will not be engaged!

The Autobrake operating is set to 75% of maximum braking force. It can be disengaged by briefly applying manual braking (press <m>).

Landing Gear

The landing gear of the MD83 consists of 2 dual wheel main gear assemblies and 1 dual wheel nose gear assembly. Normally, the gear is moved hydraulically, there is also a mechanical emergency free fall system for the landing gear.

The nosegear steering can be actuated by either rudder deflection or by use of the nose wheel tiller (activated by the appropriate keyboard command). While full rudder deflection can only turn the nosegear to 7° either side of central, using the tiller will provide a turning angle of 82° on either side.



The landing gear controls and indications are shown to the left. There is a lever which has up and down position. On the top left, the three gear status indicator lights can be seen, indicating with green colour an extended and safe gear condition. The lights will turn red while the gear is in transit or if it is not locked in the up or down position. If the gear is locked up, the lights will extinguish.

There will be a voice warning „LANDING GEAR„ together with a horn if:

- the landing gear is not locked down and throttles are at idle position and radio altitude is below 1200 ft at speeds up to 210 kts
- the flaps are extended to or beyond 28° and the landing gear is not locked down.

Power Plant

The MD83 is equipped with 2 Pratt & Whitney JT8D-219 engines. The engines are of an axial - flow, bypass type with front fan and dual rotors.

The JT8D-219 engine produces a normal take off thrust of 93390N (9520 kg, 21000 lbs) in air temperatures up to 25°. Maximum thrust is 96150N (9840 kg, 21700 lbs) with Automatic Reserve Thrust enabled.

The low pressure compressor section (N1) comprises 1 fan stage and 6 compressor stages which are driven by a 3 stage turbine. The high pressure compressor section (N2) comprises 7 compressor stages and is driven by a 1 stage turbine. Combustion takes place in 9 combustion chambers.

Controls and Indicators

The engine indicators are mounted on the centre panel and include the following instruments pictured on the left:

Left column:
Upper light: Reverser active light. Shows that the reverse buckets are in reverse position.
Reverse Unlock light: Shows that the reverse buckets are unlocked.
Wheel not turning light: Indicates that the wheels of the main gear are not turning. (Not engine related)
Fuel Temp: Indicates the fuel temperature downstream of the air/fuel heat exchanger.
Fuel Flow Indicator: Indicates the fuel flow in lbs./hr. The digital counter indicates the fuel used since reset (in lbs.).

Right Column:
EPR Indicator: Indicates the ratio of turbine discharge to engine inlet pressure as a measure of thrust output.
Target EPR is displayed with an orange marker which can either be set manually or by the thrust setting computer.

N1: This gauge shows the speed of the low pressure compressor in % RPM.
EGT: Shows the temperature aft of the 4th stage turbine in °C.
N2: This gauge shows the speed of the high pressure compressor in % RPM.

A second set of these instruments are available for the right engine. In addition, a switch called „Fuel Used Reset„ is mounted over the right fuel flow indicator. If toggled, it resets the fuel used instrument to 0.

Engine Operating Limitations

Time limits for thrust settings:	
• Take-off and go-around	Max 5 Minutes
• Take-off and go-around with One Engine Inoperative	Max 10 Minutes
Starting time	
• Fuel on to light up:	5 - 20 seconds
Fuel Flow:	
• Stabilised Idle power	Max 1100 lb./hr
• Normal Take-off thrust:	Max 12566 lb./hr
RPM	
• N1 Take-off, normal thrust	Max 98.3 %
• N2 Take-off, normal thrust	Max 100.9%
• N1 Take-off, maximum thrust	Max 101.6%
• N2 Take-off, maximum thrust	Max 102.2%
• N2 Idle	Min 50.3% Max 57%
EGT	Maximum Temperatures °C
• Start Ground	475°
• Start Flight	625°
• Idle	480°
• Take-off thrust	
• normal thrust / flex thrust	2 minutes 595°
thereafter	590°
• maximum thrust	2 minutes 630°
thereafter	625°

- In Flight
- Maximum continuous thrust 580°
- Maximum climb 580°
- maximum cruise 540°

Starting and shutting down of engines.

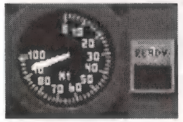
The AS2 engines feature Full Authority Digital Engine Control (FADEC) automatic start and shut down sequences. This has been introduced in order to provide assistance to the pilot who has to perform the task of 2 crew here. Starting the engines is done by pressing the E key followed by the number of the engine to be started. Only one engine may be started at a time. Shut down is achieved by pressing O followed by the number of the engine.

Key presses introduced for the MD83 Engine

In order to cover the specific requirements of the MD83, the following key presses are needed.

Reset Fuel Used	ALT-5 (numeric keypad)
Select Assumed Temperature	ALT-6 (numeric keypad)
Select Thrust Computer active	ALT-7 (numeric keypad)
Toggle Automatic Reserve Thrust (ART)	ALT-8 (numeric keypad)

Automatic Reserve Thrust



The Automatic Reserve Thrust System provides engine failure detection during take off and commands an incremental power increase on the remaining engine. ART operates independent of the Auto Throttle System (See automatic flight).

An indicator light is provided to the right of the right hand engine N2 gauge. It indicates „READY„ when ART is armed and ART if the Automatic Reserve Thrust is in use. You can toggle ART armed on and off with ALT - 8 (numeric keypad).

Thrust setting computer

The thrust setting computer provides EPR limit selection for various stages of flight. The indicators on top indicate Ram Air Temperature (RAT) and the calculated EPR limit. Below, 6 push buttons are installed to provide the different EPR limit selections.

Pushing any of these buttons will do 3 things:

Select the respective mode and illuminate the selector.
Display the calculated EPR limit in the respective window.
Set the orange bugs in the EPR gauge.

The modes available are:

TO Normal take off thrust if ART is set to AUTO (Ready light)
Maximum take off thrust if ART is switched off or if ART activates.

The computed EPR limit will be fixed when AC reaches 60 kts

TO FLX: Reduced Take Off Thrust, determined by selecting an assumed temperature higher than RAT.
GA Maximum go around thrust. Will be automatically selected by pressing the TOGA switch or if ART activates.
MCT Maximum Continuous Thrust.
CL Maximum Climb Thrust.
CR Maximum Cruise Thrust.

Thrust Reverse System

A thrust reverse system is mounted on each engine to provide increased deceleration on landing or take off abort. 2 Thrust reverse buckets are installed on each engine exhaust. Upon activation by the pilots, the buckets deploy and redirect engine thrust into the slipstream, causing rapid braking.

Controls and Indications

Thrust reverse can be selected on ground by retarding the throttles to idle position, then pressing 9 on the main keyboard, then applying thrust with the throttle.

After pressing the 9 key, verify that the reverse has activated. There are 2 reverse lights per side which indicate „Reverser unlocked„ and „Reverse„ on the secondary panel. Also, on the control panel, you will see the thrust levers moving into the red reverse range.

Reverse is cancelled by pressing 0 (zero) on the main keyboard with the throttles in idle position.

NB Computer throttles do not have any movement range below idle, so unlike the real aircraft, which has separate levers on the main throttles to apply reverse, to increase reverse thrust, you will have to move your computer throttles FORWARD after selecting reverse thrust. The on screen indication will show the throttles moving AFT because they are applying reverse thrust.

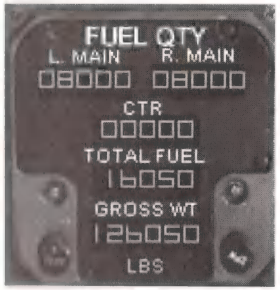
Limitations

Thrust reverse should not normally be used below 60 knots indicated, but if the need arises, (for example in icing conditions) apply idle thrust reverse only. If more than idle power is used below 60 knots with the reversers deployed, compressor stalls can occur.

Fuel System

There are 5 fuel tanks in the MD83, two wing tanks holding 9260 lb each and 1 centre tank holding 20590 lb., and 2 auxiliary tanks holding 7590 lb. to a total of 46.700 lbs.

Controls and indications



The fuel quantity indicator of the MD83 modelled in AS2 shows the fuel tank arrangement with left and right quantities, centre and aux. fuel tanks quantities (the aux. fuel tank quantities have been added to the centre tank due to panel space constraints).

Below that, total fuel quantity is indicated. In the lowest window, gross weight is indicated.

In order to display the correct gross weight, the Zero Fuel Weight must be entered manually first. To do this, determine it from the loadsheet (it is equal to the DOW of 80'000 lb. plus what ever payload you entered in the F6 / Loading menu) and then click on the button right of the window. A yellow circle appears and the figure in the GROSS WT window changes to ZFW. Adjust the ZFW now by clicking left or right of the button to decrease or increase the weight. When finished, click on the TEST button to the left of the window, and the actual Gross Weight is displayed.

Fuelling is done by the system automatically. To enter a new fuel quantity, use the „Loading„ submenu in the F6 menu.

Communication Systems

The Communication systems of the MD83 consist of 2 VHF communication radios and an ATC transponder. Both are located on the secondary panel.

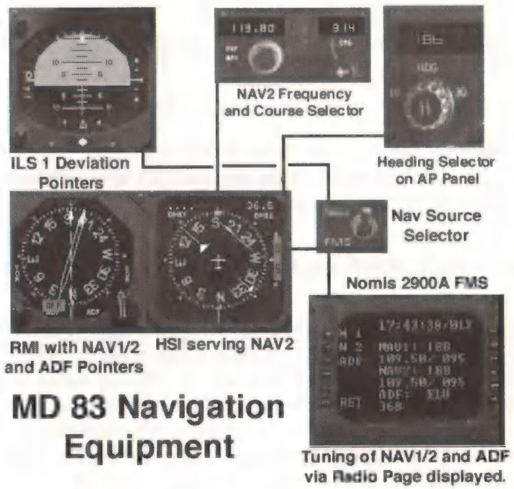
On top of this picture you can see the COM frequency selectors. They can be mouse operated or operated by the keyboard sequences.

Select COM1	Ctrl 1
Select COM 2	Ctrl 2
Select Transponder	Ctrl 3
Full MHz up/down	Ctrl = / -
Fractional MHz up/down	Ctrl [/]

To communicate with ATC, you have to select which COM radio you want to use. Use the Ctrl 1 and Ctrl 2 controls for this. The selected COM will display in yellow. You can now change frequencies using the keyboard or use the radio to talk to ATC. If you want to only listen (e.g. to an ATIS) this can be done without activating the COM but by simply setting the frequency.

The ATC Transponder has no other function other than entering the code setting or squawk. Set the assigned code by using the mouse or keyboard as described above. The Ident function will not be called for by ATC.

Navigation Systems



MD 83 Navigation Equipment

The Navigation system of the MD 83 consists of 2 VHF navigation receivers featuring ILS and VOR reception, 2 DME receivers, 1 ADF receiver and a GPS/IRS based NOMIS 2900a Flight Management System. The systems provide full navigation capabilities for all modes of navigation including RNAV as well as ILS approach capabilities down to ILS CAT 3 minima.

The picture shows the basic navigation layout of the MD 83. The navigation radios are all tuneable via the NOMIS 2900a FMC, and the NAV2 receiver can also be tuned via the separate control head on the glareshield. Both NAV receivers and the ADF receiver are centrally managed via a navigation computer which in turn takes its tuning data from the FMC.

The NAV Source Switch above the FMC allows slaving of the HSI's CDI to the route data set in the FMC. (See separate description of FMC.) While on NAV, the HSI CDI shows course deviation for NAV2, if on FMC, the CDI shows course deviation of the FMC LNAV route.

NAV 1 is represented on the RMI by using the left (thin) needle in NAV position. Additionally, if an ILS is tuned into NAV 1, ILS deviation pointers appear on the Attitude indicator on top giving course deviation information on localizer and glideslope deviation.

NOTE: The Autopilot computer uses NAV 1 for ILS approaches only. In order to fly an automatic approach, NAV 1 must be used as the primary ILS source.

The heading bug can to be set via the heading select knob on the glareshield (secondary panel). Both RMI and HSI are fed from a central gyro computer and a flux valve located in the wing area. Should a gyro failure occur, HDG flags appear in both instruments.

Controls and Indicators.

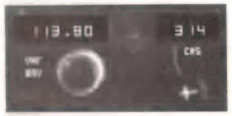
The Attitude and Flight Director Indicator of the MD83 features full flight guidance in pitch and roll axis. A black and blue sphere indicates the attitude of the aircraft in pitch and bank, relative to the orange aircraft symbol in the centre of the instrument. On the left hand side, an orange ring indicates speed deviation from the speed preselected on the AP panel. On the bottom and right side of the instrument, an orange triangle shaped indicator shows deviation from the ILS localiser and Glideslope tuned on NAV 1. The horizontal scale shows the localiser deviation, the vertical one the glideslope deviation. On the bottom edge a ball indicator shows the slip tendency of the aircraft. On the top right, a yellow DH light lights up whenever the aircraft is below the Decision Height preset on the Radio Altimeter.

The two yellow bars in the centre of the instrument are the command bars of the Flight Director Indicator. These command bars show the required roll and pitch attitude calculated by the Autoflight computer to achieve the programmed flight path. An in depth discussion of the flight director can be found in the FLIGHT DIRECTOR chapter in the flight school.

The MD 83 HSI is a standard instrument, acting as a horizontal situation display with heading information and VOR/ILS course deviation bars. The HSI shows navigation information gathered by NAV2 on its horizontal and vertical CDIs, which are located in the centre and on the right side of the instrument. A TO/ FROM arrow in the centre shows the direction of the station.

It also features a dual DME display, showing the indications of DME 1 on the left top and DME2 on the right top of the scale.

The orange heading bug is used to mark a selected heading and also features as a heading selector for the Autoflight. It can be set by using the key command „SHIFT 8„ followed by [and] on the keyboard or by using the HDG selector on the secondary panel.



The HSI's indications are controlled by the NAV 2 control panel on the glareshield. Set the frequency on the left part of the panel and the course CRS on the right part.

The Radio Magnetic Indicator is a highly flexible tool to help with navigation. It has a compass card and 2 pointers to display radio bearings. The single pointer displays bearigns for the No. 1 ADF /VOR, the double pointer for the No. 2 ADF/VOR The knobs at the bottom left and right select between ADF and VOR

The needles display QDM to the station on the arrow end, and QDR (radial) from the station on their tail end.

Both needles are used to display bearings to the selected station. The arrow end of the needle points towards the selected station. If the selector is set on ADF, the arrow gives QDM and the end QDR information. In the case of a VOR, the arrow will show the current Track to the station, the opposite end will show the current Radial from the station.

Due to the arrangement employed on this panel, the thin needle is usually set as a VOR needle for NAV 1, while the double arrow is set to display the ADF information.

The radio altimeter indicates the height above the terrain. It consists of a green altitude band with 10 ft increments, a decision height selector window on the bottom and a DH light on top of the instrument. The operation is very easy. Select the desired decision height on the window on the bottom of the instrument. When passing or below this height, the DH lights on the instrument and on the ADI will operate. When you are flying above the DH, both lights will go off.

The radio altimeter works from 0 to 2500 ft AGL.

The colour weather radar system allows detection and avoidance of thunderstorm cells. When flying in areas with thunderstorms, monitor it regularly and navigate around the indicated zones.

Thunderstorms consist of areas of cloud with distinct vertical instability. That is what makes them dangerous to aircraft. Normally, around a so called cell, there is a less violent outer cloud area around it. The radar shows the actual cell in red, the outer areas in yellow and green. It is best to avoid all of the areas.

Instruments

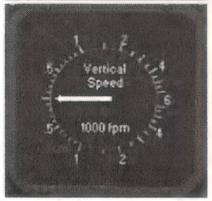
This section covers the remaining flight instruments available on the primary and secondary panel.

Pitot and Static System

The airspeed and Mach No indicator displays Indicated Air Speed (IAS) in knots. Included are a Mach Number indicator on the top of the instrument, which will indicate Mach Number as a percentage of the local speed of sound. A „barber pole„ provides information on maximum permitted airspeed. This indicator moves with altitude to allow for the less dense atmosphere at higher altitudes.

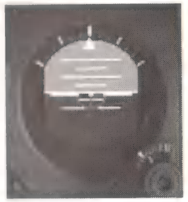
There are a total of 5 bugs attached to the airspeed indicator. A triangular bug is connected to the speed/Mach selector knob on the autopilot control panel. It will point to the speed set in the window above it. The other 4 bugs are set automatically via the NOMIS 2900A While on the ground, the FMC sets V1, Vr, V2 and Vpclean, in the air it sets the relevant flap speed and Vref.

The Altimeter indicates the barometric altitude in feet. The rotating hand shows 10 ft increments while the digital display in the upper part shows the altitude in numeric form. There are two windows to enter barometric pressure, one for the European system using Hectopascal (mb) on the left, one for the US system using Inches of Mercury (IN.HG) to the right. The pressure can be set using the knob with the orange triangle on the left of the instrument.



The Vertical Speed Indicator shows the rate of climb or descent in 1000 feet per minute. The needle will move up to indicate a climb, down to indicate a descent.

This instrument also serves as the TCAS display device, which is a transponder driven system used to help prevent collisions with other aircraft by giving audible and visible warnings of the location of any other aircraft which enters into a protected zone around your aircraft. For more information please read the chapter „Indicators and Warning Systems„.



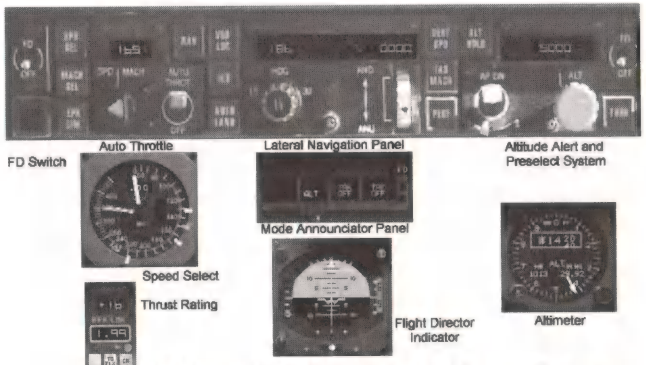
The Stand By Attitude indicator on the secondary panel gives you a back up horizon if the master horizon fails. It is also useful as a reference while working on the secondary panel.

Automatic Flight Control Systems

The MD83 is equipped with a Digital Flight Guidance System DFGS 971. The system consists of the following components:

- Autopilot (AP)
- Flight Director (FD)
- Speed Command (SC)
- Autothrottle (AT)
- Thrust rating (TR)
- Automatic Reserve Thrust (ART)
- Mach Trim Compensator (MTC)
- Yaw Damper (YD)
- Altitude Alert and Preselect

General Overview



DFGS-971 Digital Flight Guidance System

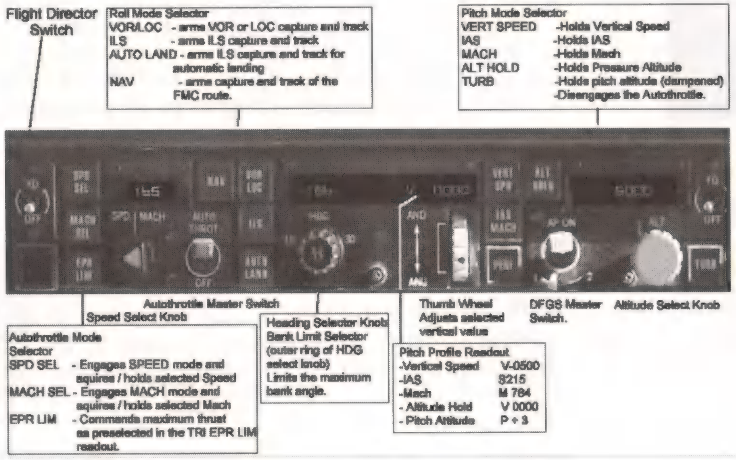
The autopilot / flight director system is an integrated part of the DFGS and may be used in all parts of the flight.

The following functions are available for autopilot and / or flight director:

- Take Off (inhibited for autopilot until lift off)
- Vertical Speed / Altitude Hold.
- IAS / Mach Hold
- Turbulence Mode
- Heading Hold / Heading Select
- VOR Capture and Tracking
- LNAV Capture and Tracking (in conjunction with NOMIS 2900A FMC)
- ILS Capture and Tracking
- Go Around
- Auto Land

Controls and Indicators

The DFGS is controlled via the Flight Guidance Control Panel (FGCP).



Special attention must be paid to the control knobs. They have different detents and must be used with care.

If you are using the mouse, (which is recommended) please note the actions :

push knob: click Mouse with CTRL key pressed
pull knob: click Mouse with SHIFT key pressed.

To rotate a knob, there are 4 locations around the edge of the selected knob that will change the setting. In the 2 o'clock position, the mouse will cause an increase at the low value of the knob, in the 4 o'clock position, the increase will be the large value of change. In the 7 o'clock position, the mouse action is to decrease the value by the large change, and at 11 o'clock, the decrease is the small value.

Operation of the HDG select knob is as follows: Normal: Heading bug select. Push: Engages HDG Hold mode. Pull: Engages Heading Select Mode. The Altitude Knob needs to be pulled to arm the preselected Altitude.

All the active modes are displayed on the Flight Mode Annunciator (FMA)
The FMA is structured to show the different mode annunciation cleanly separated. They are from left to right:

Autothrottle/Spd modes
Armed modes
Active roll mode
Active pitch mode.

In the „armed„ window (second column from the left) the upper line shows the armed roll mode, the lower line shows the armed flight level or altitude.

The 1 in the top right corner indicates that AP 1 is engaged.

An amber ILS and NO AUTOLAND error message will appear over the SPD window if the ILS indication becomes unreliable or, NO AUTOLAND appears if the autoland logic has detected a fault condition during an autoland approach.

The following tables give you all possible mode indications that may appear on the FMA.

ARM Mode annunciation

LND	LAND mode is armed
ILS	ILS mode is armed
LOC	LOC mode is armed
NAV	LNAV is armed
330	Alt Preselect is armed for automatic capturing of the selected altitude
ILS 40	ILS mode is armed for automatic capturing and Altitude Preselect is armed for automatic capture of the preselected altitude.
AUT GA	The automatic Go Around mode is automatically armed below 1500 ft if the AP is on in ILS or LND mode with flaps/slats in landing conf.

MAN GA	The manual Go Around mode is automatically armed below 1500 ft if the AP or FD is engaged in ILS Track mode with flaps in landing conf. No DFGS Go Around capability exists and the AP will disconnect if a GA is initiated

ROLL Mode annunciation

HDG HLD	Heading Hold is engaged. Maintains the mag. Heading
HDG SEL	Heading Select mode is engaged and the heading displayed in the FDGC is held.
VOR CAP	VOR mode is engaged and the automatic capture has started
VOR TRK	VOR mode is engaged and a radial is tracked
VOR CRS	VOR mode is engaged and a station passage is encountered. The heading selected in the CRS window is maintained.
NAV CAP	NAV mode is engaged and the automatic capturing of the FMC route has started.
NAV TRK	NAV mode is engaged and the FMC route is tracked.

LOC CAP LOC TRK	Localizer mode is engaged and capture / track of the localizer is started.
TAK OFF	Take Off Mode is engaged and, after lift off, the ADI roll bar commands the heading that existed at nose wheel lift off
WNG LVL	Turbulence Mode is engaged and the roll bar commands wings level
GO RND	Go Around mode is engaged. Wings level is commanded on the roll bar, if the roll attitude is less than 3° the existing HDG is maintained.
AUT LND	LAND mode is engaged.
ALN	Align mode is engaged. The aircraft heading is aligned with the runway course.
ROL OUT	Roll out mode is engaged at the main gear spin up and will remain active until AP disengagement. AP keeps the runway heading with rudder and nose wheel steering.

PITCH Mode Annunciation

VERT SPD	Vertical Speed mode is engaged and the vertical speed displayed on the FGCP Pitch window is maintained.
ALT CAP	Altitude Preselect mode is engaged and the selected altitude is being captured.
ALT HLD	Altitude Hold is engaged and the barometric altitude is maintained using pitch attitude.
IAS	IAS mode is engaged and the IAS shown on the FGCP Pitch window is maintained using pitch attitude
MACH	MACH mode is engaged and the MACH shown on the FGCP Pitch window is maintained using pitch attitude
TURB	Turbulence Mode is engaged. All armed modes are cancelled, AT is disengaged and the AC maintains the existing pitch attitude.

NO FLR	ILS mode is engaged and AC passes 100 ft RA and AP is still engaged.
SPD LOW	The AC is being manoeuvred into a low speed condition.

TAK OFF	TAKE OFF mode is engaged. After Lift off, the FD pitch bar will command: V2+10 with all engines operating. One engine out: minimum V2 and maximum V2+10. However, pitch commanded is limited to minimum 12°ANU to max 20° ANU
GS CAP	ILS or LND mode is armed and glide slope being captured.
GS TRK	ILS or LND mode is armed and glide slope being tracked
GO RND	Go Around mode is engaged. The FD pitch bar will command: min Va and maximum Va+20 of the flap setting existing at mode engagement. However, pitch commanded is limited to minimum 12°ANU to max 20° ANU
AUT LND	LAND Mode is engaged and the autoland logic is satisfied.
FLAR	Flare mode is engaged

DFGS Keystroke and Mouse Control Philosophy

Altitude Window	SHIFT A
Speed/Mach Window	SHIFT S
Heading Window	SHIFT X

Vertical Speed Window	SHIFT C
Flip Autopilot Masterswitch	SHIFT Z
Disconnect AP. FD remains on.	SHIFT Space
Flip Autothrottle Master Switch	SHIFT V
Select TOGA	SHIFT D
Select Speed Window	SHIFT S
Select Heading Window	SHIFT X
Select vertical speed window	SHIFT C
Select altitude window	SHIFT A
Depending on active Window various MCP buttons	SHIFT F1 to SHIFT F10

Mouse handling: push knob: click Mouse with CTRL key pressed
pull knob: click Mouse with SHIFT key pressed

With thrust window active:

Select Speed Mode	SHIFT F1
Select Mach Mode	SHIFT F2
Select EPR LIM	SHIFT F3
toggles speed-mach for preselect (push knob into second detent)	SHIFT F9

Hdg Window Active:

Select NAV Mode (LNAV)	SHIFT F1
Select VOR/LOC Mode	F2
Select ILS	F3
Select Autoland	F4
Reduce Max. Bank Angle by 5 degrees (min. 10 degrees)	F7
Increase Max. Bank Angle by 5 degrees (max. 30 degrees)	F8
Activates Hold of current heading (push knob)	F9
Activates selected Heading (pull knob)	F10

Vertical Speed Window:

Activates Vertical Speed	SHIFT F1
Activates IAS Hold	SHIFT F2
Activates Mach Hold	SHIFT F3
Activates Altitude Hold (V 0000)	SHIFT F4

Altitude Window:
Toggle AP1/AP2 SHIFT-F1:
Active Turbulence Mode
(Vertical Speed Window becomes Pitch input, fly pitch and thrust only). SHIFT-F2:
Arm Altitude (pull knob) SHIFT-F10:

Autothrottle Mode Ann.

CLAMP	AT is ON in CLAMP mode.
RETD	AT is on in Retard Mode
ALFA SPD	AT is on in ALFA speed mode and the throttles are being operated to maintain a save margin over stall speed.
LOW LIM	The AT is on and the AT command requires a setting lower than the minimum authority limit.
SPD 250	AT is ON and in SPD SEL mode
MACH 785	AT is ON and in MACH SEL mode
VMO LIM MMO LIM	AT is on in SPD SEL or MACH SEL mode and the actual IAS is close to the maximum overspeed limit. VMO LIM/MMO LIM engages automatically to keep the speed below the Vmo/MMO limit.
FLAP LIM	AT is ON in SPD SEL or MACH SEL and the throttles are commanded not to exceed flap limit.
SLAT LIM	AT is ON in SPD SEL or MACH SEL and the throttles are commanded not to exceed slat limit.
EPR T/O	AT is ON in EPR LIM mode and TO is selected on the TRI
EPR 54	AT is ON in EPR LIM mode and T.O Flex is selected on the TRI with assumed Temp of 54°
EPR GA	AT is ON in EPR LIM mode and GA is selected on the TRI.
EPR MCT	AT is ON in EPR LIM mode and MCT is selected on the TRI
EPR CL	AT is ON in EPR LIM mode and CL on the TRI
EPR CR	AT is ON in EPR LIM mode and CR is selected on the TRI.

Autothrottle System.

The autothrottle system works independent of AP engagement. That means, you can fly with AT engaged but AP disengaged. The AT is switched on with the AT switch on the FGCP. It will control the throttles in all the modes mentioned on the left, but will revert to manual throttle control in CLAMP mode.

Modes and Operation

Basic Mode

The basic Autothrottle modes are SPD and MACH select. Both can be selected on the FGCP.

Set the required speed or Mach number in the AT window. Then set the AT switch to AUTO THROT. Press the required button to engage the mode. THE FMA will show the relevant indication.

FMA:	_SPD	_	_	_	_
	_250	_	_	_	_
or	_MACH	_	_	_	_
	_740	_	_	_	_

To change the preselected speed,

AIRLINE SIMULATOR 2

Thrust modes

The thrust modes mentioned in the table to the left can be engaged by pressing the EPR LIM button on the AT panel. The different thrust ratings can then be set via the Thrust Setting Computer (see Power Plant). Pressing the SPD or MACH button will cancel thrust mode.

FMA:	_EPR	_	_	_	_
	_CL	_	_	_	_

EPR TO mode will initially set take off thrust once engaged but will then revert to CLMP mode. CLMP mode means the Throttles are under manual control with AT engaged. This means, that in Take Off, the joystick throttles must be moved to take off position manually during acquisition before CLMP mode is reached, otherwise the throttles may retard !

CLMP will also engage with ALT CAP mode if the Altitude selected is below the present altitude. Power must then be manually reduced to the desired setting for descent.
ALFA SPD indication.

ALFA SPD mode engages if the AT is engaged in SPD or MACH SEL mode but the preselected mode is below the current alpha speed reference value. In this mode ALFA SPD will be kept regardless of the preselected speed value.

DFGS Operational Checklists.

AP / FD basic mode

When the AP or FD is first engaged, it will enter by default in HDG HLD and ALT HLD or HDG HOLD and VERT SPD mode.

1.	FD Switch	FD	FMA		_	_	_HDG	_ALT	_
					_	_	_HLD	_HLD	_
	The Pitch Profile readout will show			V 0000					

If the vertical speed was not 0 at the time of engagement, the FMA will show differently.

1.	FD Switch	FD	FMA		_	_	_HDG	_VERT	_
					_	_	_HLD	_SPD	_
	The Pitch Profile readout will show			V+2000 (actual VS)					
2.	AP	ON if desired							

TAK OFF mode

Fast / Slow indicator and FD Pitch bar not to be followed until after lift off.

FD: Initial conditions: On ground, FD-ON, AP - OFF, lined up and cleared for Take Off.

1.	Push TOGA button	FMA	_EPR	_	_TAK	_TAK	_
			_T/O	_ =80	_OFF	_OFF	_

The FMA shows AT in EPR T/O mode, armed Altitude of 8000 ft, both pitch channel and roll channel in TAK OFF.

2. While the engines are spooling up, move the joystick throttle control lever to the take off power detent. Otherwise, engines might spool down again after CLAMP mode activated.
3. After a normal rotation and lift off, the FD Pitch bar and the FAST/SLOW indicator are centred upon reaching V2+10 kts (with 2 engines) or with OEI, at the speed that existed when the engine fails but MIN V2 and MAX V2+10.
4. To engage HDG Select, set the bug on the heading you wish to follow and pull it. (Click mouse on it with SHIFT key pressed. For activation via keyboard see above.)
5. FMA will show HDG SEL engaged.

_CLMP	_	_HDG	_TAK	_
_	_ =80	_SEL	_OFF	_

VERT SPD Mode

1. Vertical Speed mode engages when if the FD is engaged and / or the AP is on.
2. Press the VERT SPD mode button. (This deselects any other pitch mode).
   The FMA will show

_	_	_	_VERT	_
_	_	_	_SPD	_

3. The pitch profile readout on the FGCP will show V +2000 (the actual VS). To change the vertical speed, use the thumb wheel below the readout.
   The VERT SPD mode disengages if - another pitch mode is selected, - a glide slope is captured - a preselected Altitude is captured.

ALT HLD Mode

The altitude hold mode engages if:

- AP/FD is initially engaged with no vertical speed present.
- An armed altitude is capturedFMA:

_SPD	_	_	_ALT	_
_290	_ 270	_	_CAP	_

- VERT SPD mode is engaged and the thumb wheel is rotated to VS 0.
- the ALT HLD mode selector switch is pressed.
  Once ALT HLD mode has engaged, the FMA shows

_SPD	_	_	_ALT	_
_290	_	_	_HLD	_

The ALT HLD mode disengages if either another pitch mode is selected, or a glide slope is captured.

IAS or MACH hold mode

IAS or MACH hold can be selected by pushing the IAS or the MACH mode selector on the pitch channel. It adjusts the pitch so that the selected IAS or MACH is held. With AT engaged, use thrust mode only.

FMA:

_EPR	_	_	_ IAS	_
_CL	_250	_	_	_

_EPR	_	_	_ MACH	_
_CL	_250	_	_	_

The pitch profile readout will read S 290 (the actual IAS) or M 750 (the actual Mach number) Use the thumb wheel to change the value.

The IAS or MACH mode disengages if
- another pitch mode is selected,
- a glide slope is captured or
- - a preselected Altitude is captured.

HDG HLD mode

The HDG HLD mode is engaged
• Upon initial engagement of the FD/AP
• Automatically out of TAK OFF mode if a new pitch mode is engaged.
• Manually if the AP is engaged in any other cruise roll mode by pushing the HDG selector knob to the second detent. (SHIFT X followed by SHIFT F9 or mouse click with held CTRL key).

FMA:

_	_	_HDG	_	_
_	_	_HLD	_	_

In engaged in a turn the HDG HLD mode will first roll the wings level and then hold the resulting heading. The maximum bank angle is limited by the bank angle selector.

HDG hold mode will disengage when a VOR or LOC capture occurs, the HDG Selector is pulled into HDG select mode or TURB mode is selected.

HDG SEL mode

HDG SEL mode will acquire and hold the heading selected in the HDG window which is also displayed on the heading bug. It is activated by pulling the HDG select knob (SHIFT mouse click or SHIFT X followed by SHIFT F10)

FMA:

_	_	_HDG	_	_
_	_	_SEL	_	_

A new heading can be selected with the knob at any time followed again by a pull of the knob to acquire it.

HDG SEL mode will disengage when a VOR or LOC capture occurs, the HDG Selector is pushed into HDG HLD mode or TURB mode is selected.

VOR mode (and NAV and LOC mode)

VOR, LOC and NAV mode all work with the same principle, so they may be discussed in one sample.

Engagement:

VOR/LOC: Tune the VOR/LOC frequency of the selected VOR/LOC in the NAV 2 receiver. Set the CDI in the HSI on the desired course.

NAV: Pre-program a route in the NOMIS 2900A FMC. Verify the next waypoint in the PRO page and make sure that you are steering towards the correct waypoint. Set the Nav source switch to FMS and the course selector of NAV2 to the correct inbound track to the waypoint.

Select HDG SEL or HDG HLD on the AP/FD on a suitable intercept heading.
Press the VOR or LOC or NAV button.

FMA (VOR mode shown)	_	_VOR	_HDG	_	_
NAV or LOC will appear instead of VOR with other mode	_	_	_SEL	_	_

When the selected track is approached, capture mode will activate.

FMA (VOR mode shown)	_	_	_VOR	_	_
NAV or LOC will appear instead of VOR with other mode	_	_	_CAP	_	_

When the selected track has been acquired, track mode will activate.

FMA (VOR mode shown)	_	_	_VOR	_	_
NAV or LOC will appear instead of VOR with other mode	_	_	_TRK	_	_

ILS / LND Mode

ILS and LND mode both work similar in quite some degree. Both capture and follow the ILS tuned on NAV1. The big notable difference is that LND mode will initiate the auto land sequence at 1500 ft RA, ILS mode will not. Also, ILS Mode may be flown with FD only, that is manual, but LND mode must be flown with the AP engaged. The following sequence will work with LND mode and mention where ILS mode differs.

Initially, set the ILS you use on NAV1 with the correct inbound track of the ILS. Engage the FD. Select a suitable intercept heading and altitude with the HDG SEL and ALT HLD functions. Select a suitable approach speed on the AT. Then press the LND (or ILS) button.

FMA

	_SPD	_LND	_HDG	_ALT	_
LND is replaced with ILS in ILS mode	_200	_	_SEL	_HLD	_

When the aircraft approaches the localizer, it will start the capturing sequence.

FMA

	_SPD	_LND	_LOC	_ALT	_
LND is replaced with ILS in ILS mode	_200	_	_CAP	_HLD	_

When the aircraft is established on the localizer inbound track the FMA changes to

FMA

	_SPD	_LND	_LOC	_ALT	_
LND is replaced with ILS in ILS mode	_200	_	_TRK	_HLD	_

When approaching the glideslope, it will engage the capturing sequence on the pitch channel

FMA

	_SPD	_LND	_LOC	_G/S	_
LND is replaced with ILS in ILS mode	_200	_	_TRK	_CAP	_

Once the glideslope is captured, GS TRK mode will become active.

FMA

	_SPD	_LND	_LOC	_G/S	_
LND is replaced with ILS in ILS mode	_200	_	_TRK	_TRK	_

At 1500 ft, the go around mode available is evaluated and armed in the ARM window.

FMA	_SPD	_AUT	_LOC	_G/S	_
LND is replaced with ILS in ILS mode	_200	_G/A	_TRK	_TRK	_

There are 2 different Go Around modes: AUT G/A will fly the whole go around in automatic mode, that is with AP engaged. MAN G/A will command the GA on the FD but will disconnect the AP once the GA button is pressed.

Now, the ILS and LND modes start to differ. I will discuss the ILS mode first:

ILS mode will continue in the above configuration until 100 ft RA. If the autopilot is not disconnected at 100 ft RA, the pitch channel will change to NO FLR and flash for 3 seconds.

FMA

_SPD	_AUT	_LOC	_ NO	_
_130	_G/A	_TRK	_FLR	_

If the AP is disengaged in time, the FMA will continue to display the LOC and GS TRK and the Go Around mode available.

FMA

_SPD	_MAN	_LOC	_G/S	_
_130	_G/A	_TRK	_TRK	_

Automatic Landing

At 1500 ft RA, the autoland sequence begins and starts to evaluate if Autoland is possible. Also, as with the ILS mode, the Go Around capability is evaluated. If the system decides that for whatever reason autoland is not possible, the LND annunciator will flash and the NO AUTOLAND„ light will turn on. In this case, the AP disconnects at 300 ft RA.

If everything goes to plan, Autoland mode will now engage at 1500 ft.

FMA

_SPD	_AUT	_AUT	_AUT	_
_200	_G /A	_LND	_LND	_

At 145 ft RA, the runway alignment manoeuvre is initiated. The aircraft will now start a slipping manoeuvre to the runway.

FMA

_SPD	_AUT	_ALN	_AUT	_
_200	_G /A	_	_LND	_

At approximately 50 ft RA, the Flare manoeuvre starts, accompanied by retard mode of the Autothrottle (RETD, see AT modes separate)

FMA

_RETD	_AUT	_ALN	_FLR	_
_	_G/A	_	_	_

Once the main gear has spun up on ground, the nose wheel is lowered. Roll out mode engages and keeps the aircraft on the runway centreline with nose wheel steering and rudder.

FMA	_RETD	_MAN	_ROL	_ROL	_
	_	_G/A	_OUT	_OUT	_

Once the AP is no longer needed, disengage it.

LIMITATIONS: Autoland may only be performed on CAT II and III approved runways.

GO RND mode

The GO RND mode will engage if the TOGA switch is depressed. It will:

- Command a rotation to climb attitude and then adjust the pitch attitude to maintain go around speed, which is the existing IAS at initiation but minimum Va and max Va+20kt.
- Maintain the magnetic heading existing at the time of the TOGA press.
- Momentary touch down will not disengage GO RND mode.

With the AP on, this will happen automatically. If the AP is disengaged (following a MAN GA) it is the FD which will command the above.

FMA	_EPR _	_GO	_GO	_
	_G/A _	_RND	_RND	_

As with TAK OFF mode, any other roll and pitch mode will cancel GA mode.

Indicators and Warning Systems

Ground Proximity Warning System

The MD 83 is equipped with a Ground Proximity Warning System that will protect the aircraft from unintended terrain closure. The GPWS operates off signals by the Radio Altimeter and barometric rate inputs.

The GPWS operates during the whole flight but is limited in take off and approach. In take off, the system is active only 5 seconds after the gear is up or above 100 ft, whichever is later. In the approach, the system is active from below RA 2450 ft and above 50 ft.

The different modes of the GPWS are as follows:

MODE 1 Excessive sink rate „SINKRATE- PULL UP„

Mode 1 activates when the sink rate is excessive in relation to the radio height. The warning will trigger from 2450 ft and 5000 fpm to 50 ft and 1200 fpm. In between, fpm needed to trigger it will decrease linear.

MODE 2 Excessive terrain closure „TERRAIN - PULL UP„

Mode 2 activates upon excessive terrain closure rate.

MODE 3 Altitude loss on take off or go around: „DON'T SINK„

MODE 4 Unsafe terrain clearance with gear up:	„TOO LOW, TERRAIN„	speed/altitude triggered
	„TOO LOW, GEAR„	gear not down and 1000 ft AGL or below
with flaps not in landing configuration:	„TOO LOW, TERRAIN„	speed/altitude triggered
	„TOO LOW, FLAPS„	flaps not in landing configuration.

MODE 5 Glideslope deviation on ILS „GLIDE SLOPE„

MODE 6 Altitude Callouts „FIVE HUNDRED„
„THREE HUNDRED„
„TWO HUNDRED„
„ONE HUNDRED„
„FIFTY„
„THIRTY„
„TWENTY„
„TEN„

Part 1 Standard Operation Procedures

The standard operating procedures are provided to give you optimal guidelines on how to operate the aircraft in all stages of flight. It is adherence to them which will give you optimal flight parameters and therefore best results in the operation of the MD 83 / 88.

However, these checklists have been provided by human beings and cannot replace common sense and good flying practice. Also, circumstances may arise where the use of these checklists may delay needed action. In these cases, feel free to act to your own best judgement.

The Standard Operating Procedures are split into several sections. Please refer to them for all questions you might have on the operation of the flight.

1. **Flight Checklists:** **Standard flight crew checklists covering normal procedures**
2. **Expanded Checklists:** **Expanded version of the above checklists, which will give in depth explanations of each item.**
3. **Abnormal Checklists:** **Abnormal operating procedures and checklists.**
4. **Emergency Checklists:** **Emergency checklists and procedures.**

All the following checklists have been abbreviated from the real MD83 checklists, as there are limitations to the system side of the simulator. Also, items which can not be performed in the sim but are necessary for understanding of connecting items, are printed in ITALIC font. Items printed with numbers in BOLD font are memory items.

Flight Checklists

The flight checklists cover a normal flight from beginning to the end with all checkpoints needed to perform it. For explanations on the individual points refer to the Expanded Checklists below.

Cockpit Preparation

1.	Pins, Pitot covers	ON BOARD
2.	APU	RUNNING
3.	FMC	INITIALISE
4.	DFGS	SET
5.	Automatic Reserve Thrust	AUTO
6.	Thrust Rating Indicator	CHECKED / T.O.
7.	Fuel Quantity Indication	CHECKED
8.	Fuel Used	RESET
9.	Spoilers	IN/DISARM
10.	Take Off Warning	CHECKED
11.	Throttles	IDLE
12.	Fuel Levers	OFF
13.	Stabiliser Trim	CHECKED
14.	Horizons	CHECKED
15.	Radio Altimeter	SET
16.	Transponder	SET
17.	Departure Information	RECEIVED
18.	EPR Limit	CHECKED

COCKPIT PREPARATION COMPLETED

CREW AT STATIONS

1.	Cockpit Preparation	COMPLETED
2.	Equipment Check	COMPLETED
3.	Aircraft Log	CHECKED
4.	Oxygen Masks, Mikes and Regulators	CHECKED
5.	Parking Brakes	SET
6.	Aileron and Rudder Trim	CHECKED
7.	Altimeters	CHECKED
8.	MD88 only: EFIS	CHECKED
9.	Compasses	CHECKED
10.	Fuel Quantity	CHECKED
11.	Navigation/FMC	SET
12.	HSI Mode Selector	NAV
13.	RMI Selector	AS REQUIRED

CREW AT STATIONS COMPLETED

BEFORE ENGINE START

1.	Slides arm	REQUESTED
2.	Seat Belts	ON
3.	LOADSHEET / LMC	CHECKED
4.	Zero Fuel Weight	SET
5.	Stabiliser	SET
6.	Flaps	SET TAKE OFF
7.	FMC Performance Page	ENTER PAYLOAD
8.	Speed Bugs	CHECKED
9.	Start Up / Pushback	APPROVED

READY FOR PUSHBACK AND ENGINE START

AFTER ENGINE START

1.	Chocks Away	REQUESTED
2.	Flight Controls	CHECKED
3.	All Clear Signal	RECEIVED
4.	Flaps / Slats	TAKE OFF
5.	Off Blocks Time	NOTED

READY TO TAXI

TAXI CHECK

1.	Brakes	CHECKED
2.	Flight Instruments	CHECKED
3.	ATC Clearance	VERIFIED
4.	Take Off Briefing	COMPLETED
5.	Flaps / Slats / V-Speeds	RECHECKED
6.	EPR Bugs	RECHECKED
7.	ART	CHECKED
8.	Flight Attendants	INFORMED
9.	Cabin	SECURED
10.	Windows	CLOSED
11.	Annunciator Panel	CHECKED

TAXI CHECK COMPLETED

CLIMB

1.	Altimeters	SET / COMPARED
2.	Spoilers	DISARMED / RETRACTED
3.	Flaps / Slats	UP / CHECKED
4.	Thrust Rating Selector	CLIMB
5.	ART	AUTO
6.	Landing / Taxilights	RETRACTED / OFF
7.	Seat Belts	AS REQUIRED

CLIMB CHECK COMPLETED

DESCENT

1.	Landing Data	CHECKED
2.	Approach Briefing	COMPLETED
3.	HSI Mode Selector	AS REQUIRED
4.	Navigation	SET

DESCENT CHECK COMPLETED

APPROACH

1.	Seat Belts	ON
2.	Altimeters	SET AND COMPARED
3.	Radio Altimeter	SET MDA/H
4.	LNAV Mode	DISENGAGED
5.	RMI Selectors	SET

APPROACH CHECK COMPLETED

FINAL CHECK

1.	GEAR	DOWN
2.	FLAPS / SLATS	28 / 40 / LAND
3.	SPOILERS	ARMED

FINAL CHECK COMPLETED

AFTER LANDING

1.	Flaps	15
2.	Spoilers	RETRACTED
3.	Landing Time	NOTED

AFTER LANDING CHECK COMPLETED

PARKING CHECK

1.	Flaps / Slats	UP
2.	Parking Brakes	SET
3.	Engines	STOP
4.	Seatbelts / Slides	OFF / DISARMED

PARKING CHECK COMPLETED.

EXPANDED FLIGHT CHECKLISTS

Cockpit Preparation

1.	Pins, Pitot covers	ON BOARD
2.	APU	RUNNING
3.	FMC	INITIALISE
	- Initiate NOMIS 2900a FMC according to instructions	
4.	DFGS	SET
	- Set FD switch to FD	
	- Check Auto Throttle switched off	
	- Check AP switch off	
	- Set DFGS selector to flying pilots side	
5.	Automatic Reserve Thrust	AUTO
	- Check the ART switch to be in AUTO position and the READY light, the ART light to be OFF.	
6.	Thrust Rating Indicator	CHECKED / T.O.
	- Push T.O, check no flag, NO MODE light out.	
7.	Fuel Quantity Indication	CHECKED
8.	Fuel Used	RESET
	- Switch the RESET toggle switch on the centre panel to RESET. Check fuel used indicators going to 0.	
9.	Spoilers	IN/DISARM
10.	Take Off Warning	CHECKED
	- Move both throttles forward until take-off horn and vocal warning (FLAPS/SLATS) come on. Move both throttles to idle and observe that the warning goes out.	
11.	Throttles	IDLE
12.	Fuel Levers	OFF
13.	Stabiliser Trim	CHECKED
14.	Horizons	CHECKED
15.	Radio Altimeter	SET
16.	Transponder	SET
17.	Departure Information	RECEIVED
18.	EPR Limit	CHECKED
	- Check EPR LIM to correspond to chart value according to RAT.	

COCKPIT PREPARATION COMPLETED

CREW AT STATIONS

1.	Cockpit Preparation	COMPLETED
2.	Equipment Check	COMPLETED
3.	Aircraft Log	CHECKED
4.	Oxygen Masks, Mikes and Regulators	CHECKED
5.	Parking Brakes	SET
6.	Aileron and Rudder Trim	CHECKED
7.	Altimeters	CHECKED
	- Set QNH on the altimeters	
8.	MD88 only: EFIS	CHECKED
	- Set RANGE as required	
	- Set Details as required	
9.	Compasses	CHECKED
10.	Fuel Quantity	CHECKED
11.	Navigation/FMC	SET
	- Set and check frequency and course on NAV1.	
	- Set 250 Kt or limiting speed on SPD/MACH readout and check bug movement	
	- Set the runway heading on the HDG readout and compare heading bug.	
	- Set bank angle limit as required.	
	- Set initial climb altitude in the ALT window, pull ARM and check readout on the annunciator.	
	- Set and check frequency and course on NAV2.	
	- Set and check frequency of the ADF.	
12.	HSI Mode Selector	NAV
	- Set the HSI mode selector switch on NAV and confirm the readout.	
13.	RMI Selector	AS REQUIRED
	- As a standard, set the left selector on NAV and the right selector on ADF.	
	- If ADF is not used, set the right selector on NAV as well.	

CREW AT STATIONS COMPLETED

BEFORE ENGINE START

1.	Slides arm	REQUESTED
2.	Seat Belts	ON
3.	Loadsheet / LMC	CHECKED
	- Check the loadsheet	
	- Insert the Payload in the FMC Performance Page	
4.	Zero Fuel Weight	SET
	- Set the ZFW on the ZFW window. Check Gross Weight with Loadsheet.	
5.	Stabiliser	SET
6.	Flaps	SET TAKE OFF
	- Set the flaps to the Take Off position and check the indication.	
7.	FMC Performance Page	ENTER PAYLOAD
	- Check entered payload and change if necessary.	
8.	Speed Bugs	CHECKED
	- Check external bugs are set on V1, V2, V0flaps and V0slats	
	- Recheck the setting of the internal bug	
9.	Start Up / Pushback	APPROVED

READY FOR PUSHBACK AND ENGINE START

Normal Engine Start Procedure

1. Check outside clear and all clear signal received.
2. Set Engine no 2 to Autostart (E2)
3. Observe N2 and N1 rise
4. Observe fuel flow and EGT rise
5. Check engine stabilised.
6. Repeat 2-5 on no 1 engine.

AFTER ENGINE START

1.	Chocks Away	REQUESTED
2.	Flight Controls	CHECKED
	- Move all flight controls over the full range. Check sensitivity of Joystick and adjust if necessary.	
3.	All Clear Signal	RECEIVED
4.	Flaps / Slats	TAKE OFF
	- Recheck flaps and slats position and set according briefing if necessary.	
5.	Off Blocks Time	NOTED

READY TO TAXI

TAXI CHECK

1.	Brakes	CHECKED
2.	Flight Instruments - Check indications of all flight instruments in various turns	CHECKED
3.	ATC Clearance - Verify ATC clearance and check navigation aids . - Set DFGS accordingly - Arm restricting Altitude - Check FMA - Set Transponder to assigned code.	VERIFIED
4.	Take Off Briefing	COMPLETED
5.	Flaps / Slats / V-Speeds - Recheck Take Off Weight - Recheck take off flaps and slats and corresponding bug setting	RECHECKED
6.	EPR Bugs - Check required thrust set on TRI and ASSUMED TEMP, NO MODE light out. - Check RAT readout on thrust rating indicator shows approximately OAT - Check EPR LIM readout and EPR bugs correspond	RECHECKED
7.	ART - If no derating, check ART switch in AUTO, green READY light on. - If derating, check ART switch in OFF, green READY light off.	CHECKED
8.	Flight Attendants	INFORMED
9.	Cabin	SECURED
10.	Windows	CLOSED
11.	Annunciator Panel	CHECKED

TAXI CHECK COMPLETED

CLIMB

1.	Altimeters - Set altimeters to 1013,2 hpa when passing transition altitude. - Crosscheck altimeter reading	SET / COMPARED
2.	Spoilers	DISARMED / RETRACTED
3.	Flaps / Slats - Check flaps in UP position - Check slat TAKE OFF, LANDING and AUTOLAND light out.	UP / CHECKED
4.	Thrust Rating Selector - Check CL button illuminated	CLIMB
5.	ART	AUTO
6.	Landing / Taxilights	RETRACTED / OFF
7.	Seat Belts	AS REQUIRED

CLIMB CHECK COMPLETED

DESCENT

1.	Landing Data - Calculate Landing Weight - Check expected landing weight to correspond to Gross Weight reading on the Fuel QTY panel minus the descent fuel. - Select FMS performance page to set speed bugs	CHECKED
2.	Approach Briefing - Brief Approach as laid out in the according chapter of the flight school.	COMPLETED
3.	HSI Mode Selector - If still on FMC LNAV coupled, HSI selector may stay in FMC position. Be aware of this and set to NAV latest when arming approach mode.	AS REQUIRED
4.	Navigation - Set and check frequency and course on NAV1. - Set 250 Kt or limiting speed on SPD/MACH readout and check bug movement - Set bank angle limit as required. - Set initial climb altitude in the ALT window, pull ARM and check readout on the annunciator. - Set and check frequency and course on NAV2. - Set and check frequency of the ADF.	SET

DESCENT CHECK COMPLETED

APPROACH

1.	Seat Belts	ON
2.	Altimeters - Set altimeter to QNH and check readout.	SET AND COMPARED
3.	Radio Altimeter - Set applicable minimum MDA/H for the selected approach.	SET MDA/H
4.	NAV Mode - Disengage NAV mode if engaged and set HSI selector to NAV. Use HDG SEL or other roll mode for interception.	DISENGAGED
5.	RMI Selectors - When flying ILS or Autoland Approach: - Set RH selector on ADF - Set LH selector on VOR - When flying a non precision approach: - Set RH selector on VOR - Set LH selector on ADF	SET

APPROACH CHECK COMPLETED

FINAL CHECK

1.	**GEAR**	**DOWN**
2.	**FLAPS / SLATS**	**28 / 40 / LAND**
3.	**SPOILERS**	**ARMED**

FINAL CHECK COMPLETED

AFTER LANDING

1.	Flaps	15
2.	Spoilers	RETRACTED
3.	Landing Time	NOTED

AFTER LANDING CHECK COMPLETED

PARKING CHECK

1.	Flaps / Slats	UP
2.	Parking Brakes	SET
3.	Engines	STOP
4.	Seatbelts / Slides	OFF / DISARMED

PARKING CHECK COMPLETED.

Part 2 Flight Procedures

1. Taxi

Before leaving the stand, make sure the intended taxi path is clear of obstacles.
If required, use thrust up to 70% N2 to get aircraft moving. Do not use reverse thrust on taxi unless required by unusual circumstances.

2. Take Off and Initial Climb

Take off shall be flown using Auto Throttle and Pitch channel in Take Off mode.

Before take off, the V-Speed markers must be set to the correct values. Make sure the FMC Performance page is set properly by entering the correct payload onto the page. You can then read off the V-Speeds that get set automatically to V1, Vr and V2. Manually set the internal bug to V2+10 kts, which will be the first target speed for the initial climb out. Heading bug must be set to the correct runway heading. Engage the FD in Take Off mode on both pitch channels. (Indication TAK OFF on both Pitch channels).

In normal take off conditions, the take off technique is very conventional. On entering the runway check if the approach sector is clear. In order to use the maximum runway, line up the aircraft carefully on the threshold. Check the runway heading and runway markings carefully. Take note of the taxi fuel used. When cleared for take off, make a time check . Two possibilities are considered: Standing Take Off or Rolling Take Off. In the standard take off scenario, which has to be executed when either of the following conditions apply:

- Actual TOW is close to MTOW or RTOW for the runway and obstacle
- Visibility / RVR is low and close to the take off minimum
- The runway is contaminated
- There are icing conditions present

Line up the aircraft and stop it, setting the parking brake. Advance the throttles to about 1.4 EPR and wait for the engine power to stabilise at that value. Call out „Take Off„ and engage the Auto Throttle. Check the FMA for EPR TO or EPR XX (when using FLEX power). Verify that take off power is reached before 60 knots are reached. When take off power is reached, the indication CLAMP will appear in the FMA. Once CLAMP appears call out „CLAMP, Take Off Power set!„. Use slight forward pressure on the yoke until reaching Vr. First Officer will call out 80 knots, V1 , Rotate (Vr), V2. When reaching Vr start a smooth and continuous rotation to 20 degrees nose up, using about 3 degrees per second rotation. Mind that more than 10 degrees nose up before unstick will cause a tail strike.

Caution: If you are using a joystick with throttle control, move the throttle control forward to the take off detent while the engines are spooling up. In CLAMP mode, the throttles will keep to the position of the joystick throttles and therefore retard if throttle is kept in idle power position.

Initial Climb.

Once the aircraft has left the ground and a positive rate of climb is established, select the gear up.
Maintain V2+10 kts to 3000 ft AGL while not exceeding 20 degrees nose up. The FD pitch bar may be used but the speed should be the primary reference. At 1500 ft set climb power on the TRI by pressing the CL button. At 3000 ft, start accelerating to the required climb speed and start flaps and slats retraction. MAX IAS is 250 kts below 10000 ft.

Climb and Cruise

For normal climb use airspeed 290 KIAS / Mo.75 above FL 100. If the planned cruise speed should be lower than the above speeds, reduce speed to cruise mach before reaching the cruising level. For a high speed climb use a 310 KIAS / M 0.75 setting.

Descent

For normal descent use cruise Mach / 290 KIAS above FL100, 250 KIAS below FL100. For high speed descent it is allowed to use M0.80 / 320 KIAS above FL100. Avoid high pitch down angles, keep pitch above 12 degrees nose down. If you need drag to slow you down, use the speed brakes.

Approach

The approach shall be carried out with either flaps 28 or flaps 40, depending on conditions. In good conditions, flaps 28 are best for noise abatement and economy. In any other conditions, flaps 40 must be used, such as with a contaminated runway or if technical malfunctions prescribe an increase to Vref. Flaps 40 is also recommended to be used in any non precision approach.

The speed bugs are again automatically set by the FMC once the performance page is called up. Make sure to call it at least once when performing the approach check. The bugs are set on V0slats, V0flaps and Va15. The internal bug must be manually set on the appropriate Va speed.

The radio altimeter should be set on the DH if stated in the approach chart, otherwise, if the approach charts are DA based, it shall be set to 200 ft for a precision approach and 300 ft for any other approach.

Fly a standard approach profile as laid out in the Approach and Landing chapter above. Start the approach with Flaps 15 and gear down. Once the glidepath is moving, select flaps 28 and reduce to Va28. If flaps 40 are needed or prescribed, set them on intercepting the glidepath. Fly the whole approach with the according Va speed, that is Va28 or Va40. Once GS TRK is established, set the go around altitude on the altitude window. Check Outer Marker or its substitute and perform the final check. Follow the RA guidance calls. At the minimum decide whether to land or go around.

A non precision approach is flown essentially the same way as a precision approach. Between the step down points, fly a calculated rate of descent to reach the next step down point at the correct altitude. Perform the final check after leaving the last step down altitude and before reaching the minimum descent altitude. Never leave a MDA before being established on a 3 degree glidepath to the runway, assured by VASI or PAPI.

If an IMC approach is to be followed by a circling, fly the approach with flaps 28 and gear down. Set flaps 40 only when fully established on the 3 degree glidepath assured by VASI or PAPI.

If a fully visual circling is required, aim to reach the downwind segment with flaps 15 and Vp15. Abeam the runway, select gear down, abeam the landing threshold select flaps 28 and fly with Vp28. Leave the circuit altitude, which is normally about 1500 ft AGL but not lower than the circling minimum, when established on the 3 degree glidepath. Once in descent, fly Va28. Select flaps 40 when fully established on the 3 degree glidepath assured by VASI or PAPI and fly Va40.

Perform the final check, once landing configuration has been established.

Go Around

Once the decision has been taken to go around, pitch and power must be immediately adjusted to climb attitude. Depress the TOGA switch on the throttles (SHIFT D) to obtain TOGA power setting. Simultaneously, rotate the nose up to arrest the descent. Set flaps 15 immediately. Maintain Vga15 and maximum 20 degrees nose up. Once positive rate of climb is achieved, and not before, select the gear up. Climb to save altitude before continuing with a normal climb out profile.

Landing

Once landing decision has been made, maintain the glidepath until touch down. Check the extension of the ground spoilers immediately upon touch down. Select at least idle reverse after the nose gear is on the ground. (Idle reverse is the desired reverse mode for noise abatement. If you feel you need more reverse, by all means use it.) Reverse should be in idle mode or cancelled below 60 knots. It should definitely be off before leaving the runway.

During the landing roll, maintain direction with rudder and nose wheel steering. Apply light forward pressure on the yoke to keep the nose wheel on the ground.

In crosswind conditions, aim for a positive touch down. Use the low wing method on dry runways. (Wing tip will hit at more than 8 degrees bank!) Use partial crab technique with contaminated or wet runway. Positive forward force may be required on contaminated runways to maintain directional control.

Use wheel brakes decisively after touch down.

Low Visibility Approaches

Flying CAT II and IIIa approaches is rather easy, but it requires a clear understanding of the autopilot capabilities. Some things are paramount, I shall summarise them quickly:

- Prepare well for this kind of approach. It is here that really all parameters have to be right before you start the approach. Brief thoroughly. Use the intermediate approach to configure the aircraft correctly. Once you have LOC TRK and G/S TRK, the aircraft should be in full landing configuration.
- Use NAV I as primary navaid, only NAV I is capable of locking to the LND mode. However, use NAV 2 as well. BOTH NAV receivers need to be on line and receive the ILS properly.
- Supervise the approach as if you were flying it by hand. Watch what the aircraft does. If something is not right, immediately go around.
- Keep to the limitations. You can't expect good results if you operate outside the DFGS limitation. (For the MD83 these are: X wind limit 20 kts, tailwind limit 10 kts, DH 20 ft, full flaps).

Part 3 Emergency and Abnormal Procedures

Abnormal Procedures

This section includes procedures for various malfunctions and problems that may arise in flight. In any event of a possible malfunction, it is paramount to fly the aircraft first, that means to keep the aircraft in a clear and safe flight path and ensure continuation of flight as well as possible in the circumstances. Only once that has been clearly established, a clear scheme of analysis and action must be put in force to deal with the emergency.

It is one of the „shortcomings„ of any PC based flight simulator that normally, we are talking here of a single crew environment as opposed to a multi crew environment on the real aircraft. This has been taken into account when designing the systems of the simulated aircraft. Many „assisting pilot„ jobs have been cut in order not to overload the PC Pilot with debugging and systems analysis while still trying to fly the aircraft. For the same reason, the number of possible failures has been contained to such failures that affect flying first and foremost, while simple system faults that require nothing but switch throwing, have been omitted.

Generally, when dealing with abnormal procedures and malfunctions, the scheme PPAA has been known to get good results. It is very much recommended here as well.

Power	Make sure that power is available to keep flying. Increase power if necessary to MCT or MTOP.
Performance	Make sure that any drag related features are in their proper configuration, such as gear, flaps and spoilers. The more drag you have, the less performance the aircraft will give you.
Analysis	Asses the situation and set the necessary priorities.
Action	Once you are clear on what your problem is, begin action according to the abnormal/emergency checklists and good airmanship. Create favourable conditions in regard to selection of landing field, ATC, and cabin.

With good planning, done within a reasonable amount of time, you will find dealing with emergencies and anomalies can become a challenge rather than nightmare.

One Engine Inoperative Operation (OEI OPS)

Rejected Take Off

If you decide to reject a take off, quick action is needed. Move both throttles to the idle position. Select reverse thrust as soon as feasible. Extend the spoilers and brake. Only once the aircraft has come to a complete stop, start assessment of the situation and order evacuation if necessary.

Engine Failure at/after V1

Continue take off run, keep the aircraft on centreline with rudder.
Do not rotate before Vr.
At Vr, rotate the aircraft to about 13 degrees of nose up.
Time permitting, check if the ART light has come on.
Climb with V2 to clean up altitude, normally 1500 ft AAL. Retract the gear as soon as a stable climb has been attained. Follow FD in TAK OFF mode but keep IAS as the main reference. Use AP if feasible, it will take pressure away from you to deal with the other tasks.
Once you reach the clean up altitude, accelerate so as to attain flaps and slats retraction speeds. Retract flaps and slats as soon as possible. Accelerate to the 1 engine climb speed and continue climb. Select MCT on the TRI.

Approaches with one engine inoperative.

Approaches with one engine out are identical to 2 engine approaches except for some configuration changes.
Use flaps 11 until lined up for approach.
Use flaps 28 and Va28 for approach with or without glideslope.
On non precision approaches without glideslope information: Never leave the MDA before safely established on the 3 degrees glidepath indicated by VASI / PAPI.

If you have to fly a visual circuit with one engine inoperative, use flaps 28 for landing.

Abnormal Approaches and Landings

If an abnormal condition for landing exists, consider diversion to a suitable airfield that allows best safety for approach and landing. Make sure the airfield is ILS equipped, that is with full localizer and glide slope information available. Select the longest runway available to you, keeping an eye on actual conditions.

For corrections to landing distances etc. refer to the emergency / abnormal checklists.

With approach speeds exceeding 150 KIAS, be aware that FD pitch information will become extremely sensitive, so use raw data as primary reference.

Be aware that a tail strike occurs at approximately 10 degrees ANU.

Make sure a stabilised approach is flown down to touch down.

Clean Approach (0 flaps landing)

Whenever possible select a runway of 3000 meters length or more. Due to the extreme approach speeds, watch FD and refer to raw data.

Select the gear down early to provide drag.
Disengage Autothrottle.
When intercepting the glidepath, set EPR to 1.10. The attitude for approach will be approximately 3 degrees ANU.
Retard the throttle levers at RA 50 ft over the threshold.
Keep the approach attitude until touch down.
Use all necessary reverse thrust.

Approach with slats extended but flaps up.

This approach configuration is very dangerous as it is prone to tail strikes. It should be avoided. A clean configuration is preferable to one with slats only.

If you are forced to fly such an approach, keep about 7 degrees ANU until touch down. Remember that at 10 degrees a tail strike will occur.

Approach with slats extended and partial flaps (11 or 15 degrees)

The approaches with flaps 11 or 15 are equal to normal approach. The approach attitude will be about 2 degrees ANU.

Operation with Unreliable Airspeed

The airspeed information can become unreliable for a number of reasons. Failure of instruments, air data computer and other information may lead to unreliable IAS, MACH, the various overspeed warnings etc. This is a quite serious threat to safety. In such cases, only attitude flying and power setting can solve the problem.

Plan and fly the flight with the following configuration and power settings:

- Take Off: Leave throttles in present position and climb with 15 deg. ANU to safe altitude.
- Cruise: Fly 2 deg. ANU at any altitude. Use power setting according Cruise Control tables.
- Descent: Set throttles to idle and use the following pitch values:
  - 2 deg AND to FL 300
  - 3 deg AND to FL 200
  - 4 deg AND to FL 100

  Level off at FL 100 with throttles idle. When pitch reaches 3 degrees ANU ,set flaps 11, wait again for 3 degrees ANU and set flaps 15.
- Intermediate approach: Flaps 15, gear up or down, fly 5 degrees ANU.
- Final approach, gear down, flaps 40, fly 1 degree ANU on G/S.
- Missed approach: flaps 15, gear up, at least 90% N1, rotate to 13 deg ANU until flaps 15 are set then to 15 degrees ANU.

The following table will give you an overview over the pitch / power relations. It is also useful when first trying to fly the aircraft.

Weight 50 t	Config	Attitude	N1 %	EPR	Resulting IAS
Cruise	clean	ANU 2 deg	80% 75% 70%	See cruise ctrl	M.74 @ FL350 S290 @ FL250 S290 @ FL150
Descent fly pitch	clean	AND -2 deg AND -3 deg AND -4 deg	idle	N/A	M.74 @ FL300 S290 @ FL200 S290 @ FL100
Holding fly level	flaps 15	ANU + 5 deg	60 - 65 %	1.2 to 1.25	Vp15 +5
Int. Approach fly level	flaps 15 Gear Down	ANU + 5 deg	65 - 70 %	1.25 to 1.35	Vp15 +5
Fin. Approach	flaps 40 Gear Down	ANU + 1 deg	55 - 60 %	1-15 to 1.20	Va40 +5
G/A	flaps 15	ANU 13-15	Min 90 %	1.80 to 1.95	Min Vga

ANU = Aircraft Nose Up, AND = Aircraft Nose Down.

AIRLINE SIMULATOR 2

Emergency Checklists

The following checklists cover emergencies which can be simulated using Airline Simulator 2. Emergencies not possible to simulate have been omitted. Some vital checklists however, tough their implementation is limited, have still been included for completeness sake.

MD 83 EMERGENCY CHECKLISTS

ENGINE	All Engine Flame Out Engine Failure In Flight Engine Restart in Flight OEI Operation
FLIGHT CONTROLS	Stab Trim Runaway Stabiliser Jammed Aileron Jammed Rudder Jammed Flaps Assymetry
EMERGENCY	Cockpit - Emergency Landing
LANDING	Ditching Emergency Preparation Evacuation Landing Procedures On Ground Emergencies

ALL ENGINE FLAME OUT

1. IAS PRESELECT	220 KIAS
2. OPEN DESCENT MODE	ENGAGE
3. THROTTLES	IDLE
4. Oxygen Masks	As Required
5. Nearest Airfield	Locate
6. ATC	Inform

RESTART ATTEMPT (2 per side)

1. Engine Starter Switch	ON
If Engine Restarts	
2. Power	Apply
3. Other Engine	Restart

If one or both engines restarted, continue descent and land at nearest available airfield.
If no engine restarted, then go to EMERGENCY LANDING Checklist

ENGINE FIRE IN FLIGHT /or severe Damage / Separation

1. Affected Engine	Identify
2. Affected Throttle Lever	Close
3. Affected Engine Shut Off Switch	Close
4. Above FL 290	Initiate Descent to FL 290
5. IAS PRESELECT	250 KIAS / Mach 0.7
6. IAS DESCENT MODE	ENGAGE

ENGINE FAILURE IN FLIGHT

1. Affected Engine	Identify
2. Affected Throttle Lever	Close
3. Power on Good Engine	MCT or As Required
4. Above FL 290	Initiate Descent to FL 290
5. IAS PRESELECT	250 KIAS / Mach 0.7
6. IAS DESCENT MODE	ENGAGE

RESTART ATTEMPT

1. Engine Starter Switch	ON
If Engine Restarts	
2. Power	Apply

ENGINE FIRE ON GROUND

1. Affected Engine	Identify
2. Engine Shut Off Switch	L / R OFF
3. Fire Handle if Available	Pull
If Fire Persists	
4. Park Aircraft into the Wind	

Perform On Ground Emergency Checklist.

ENGINE RESTART IN FLIGHT

1. Engine Starter Switch	ON
If Engine Restarts	
2. Power	Apply

ONE ENGINE INOPERATIVE (OEI) OPERATION

1. Nearest Suitable Airfield	Determine
2. ATC	Inform

3. Perform Normal Descent, Approach and Final Checklist.

FLIGHT CONTROLS

Stabiliser Trim Runaway

1. Autopilot	OFF
2. Manual Controls	Check
3. Manual Trim via Keyboard	Check
If problem persists:	
4. Controls	Disconnect (ALT J)
If problem is solved:	
5. Autopilot	Engage
6. Continue with Jammed Flight Controls Checklist	

STABILISER / AILERON / RUDDER JAMMED

1. Autopilot	OFF
2. Manual Controls	Check
If Problem Persists:	
3. Joystick Disconnect	ALT J
4. Autopilot	ON

5. Continue Flight to a ILS CAT III equipped Airport.

EMERGENCY LANDING AND EVACUATION

COCKPIT EMERGENCY LANDING

Preparation:

1. Distress Call
2. Select Landing Place
3. Brief FA / PAX
4. Reseating
5. Secure Cockpit loose Equipment
6. Burn Fuel as Situation demands
7. Life Vests ON (Ditching only)

DESCENT / APPROACH

Flap Setting for Approach and Landing 28°

1. Approach Briefing	Completed
2. Seat Belts	ON
3. Altimeters	Set
4. Landing / Ditching / Evacuation Briefing	Completed

Landing Procedures with Gear Malfunctions:

Nose Gear Up:

1. Seat Passengers Aft, check CG
2. Touch down normally
3. Keep Nose high
4. Lower Nose before Elevator Effectiveness is lost.
5. Use maximum braking once Nose is down.

1 Main Gear Up rest down:

1. Sidewards Clearance about 150 m
2. Seat Pax near emergency exit
3. Hold unsupported wing high, do NOT use Spoilers.
4. Maintain directional control with rudder and nose gear steering.
5. When wing touches the ground, apply brakes for directional control.

Belly Landing (or Nose Gear down only)

1. Seat Pax near emergency exit
2. Touch down with minimum sink rate and speed. Do NOT stall.

Before Landing / Ditching

1. Gear	Landing:	Down or up at PIC discretion
	Ditching:	Up.
2. Radio Altimeters		Set
3. Flaps and Slats		Set 28°
4. Spoilers		Armed when not landing with one main gear up.
5. Brace for Impact Signal		1 Minute before Landing.

On Ground Emergency Checklist

CAPTAIN:

1. Park Brake	Set
2. Evaluate Situation	
3. Inform ATC	
4. Evacuation Order	Yes: Given No: „Passengers and Crew keep your seats„

FO:

1. Engine Shut Down Switches	Closed
2. Fire Shut Off Switches	Both pulled and discharged
3. Emergency Lights	ON
4. Battery	OFF
5. Flaps	DOWN

EVACUATE

Part 4 Performance

General Procedures and Tables

The basic performance layout tables in this manual are laid out in pounds, as the aircraft had all instruments installed using lb. gauges.

Operating Limitations

The following limits apply to the normal and abnormal operation of the airplane.

Altitudes	Maximum Altitude	37'000 ft
	Max Field Elevation TO/LD	8'000ft
	Threshold crossing	42 ft
Speeds	Gear Extension	320 KIAS 0.70
	Gear Extended	320 KIAS 0.70
	Gear Retract	240 KIAS 0.57
	Vne / MMO	340 KIAS 0.84
	Rough Air Penetration	285 KIAS 0.79
Maximum Slats Speed	TO Position	280 KIAS 0.57
	LAND Position	240 KIAS 0.57
Maximum Flap Speeds	0-11°	280 KIAS 0.57
	11-15°	240 KIAS 0.57
	16-40°	200 KIAS 0.57
Autopilot Engagement	After Take Off	250 ft AGL
	Non Precision Approach	50 ft below MDA

		TW	CW	HW
Wind Components	CAT III and III approaches	10	10	25
(Speeds in KTS, Tailwind,Crosswind, Headwind)	Autoland CAT I	19	25	25
	Braking action	good	10	30
		fair	5	15 take off 10 landing
		poor	4	10 take off 5 landing
		nil or unreliable: Not authorised.		

Engines — **See in Power Plant Part of this Manual.**

Fuel	Imbalance	Total 2-3 to total 1-4	6000 lb
		tank 1 to tank 4	3000 lb
		tank 2 to tank 3	6000 lb
	Landing Minimum		2500 lb

Speeds

Take Off

The basic take off speeds for flaps 11 take off setting are all provided in the PERF section of the NOMIS 2900A FMC. For completeness sake, here the basic speeds and weight for the flap settings provided.

Basic Take Off Speeds JT8D-219
Flap   Take Off Weight 1000 lb.

Deg		85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
	V1	119	123	128	133	137	142	145	151	155	159	163	167	171	175	178	182
0	Vr	130	134	139	143	147	151	155	159	163	167	170	174	178	181	185	188
	V2	148	145	150	153	157	161	165	168	172	176	179	183	188	190	193	197
	V1	119	119	119	119	119	119	119	123	127	130	133	137	140	143	146	149
11	Vr	123	123	123	123	123	123	123	127	131	134	137	140	145	150	151	153
	V2	132	132	132	132	132	133	136	140	143	146	149	152	155	157	160	164
	V1	112	112	112	112	112	114	117	121	125	128	131	134	138	141	144	148
15	Vr	120	120	120	120	120	122	125	129	131	134	137	140	143	146	149	151
	V2	129	129	129	129	129	131	135	137	141	143	145	149	151	154	157	159

The following corrections for altitude and temperature need to be applied:

Alt	Temp C	-40 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50
SL	corr V1 / Vr	0	0	0	0	1/0	2/1	3/2	4/2
1000	corr V1 / Vr	0	0	0	1/0	2/1	3/2	4/2	5/2
2000	corr V1 / Vr	1/0	1/0	1	2/1	3/1	4/2	5/3	6/3
3000	corr V1 / Vr	1	2/1	2/1	3/1	4/2	5/2	6/3	7/3
4000	corr V1 / Vr	2/1	3/1	3/2	4/2	5/2	6/3	7/3	8/4
5000	corr V1 / Vr	4/2	4/2	4/2	5/2	6/3	7/3	8/4	
6000	corr V1 / Vr	5/2	5/2	5/3	6/3	7/3	8/4	9/4	
7000	corr V1 / Vr	6/3	6/3	6/3	7/3	8/4	9/4		
8000	corr V1 / Vr	6/3	7/3	7/3	8/4	9/4			

Following take off, the following speeds need to be followed:

Climb speeds	Take Off Weight 1000 lb.															
	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
V0flaps	137	137	137	137	137	138	141	145	148	151	154	157	160	162	165	169
V0slats	153	157	161	165	169	173	177	181	185	188	192	195	199	202	206	209
Vclean	168	173	177	182	187	191	195	199	205	208	212	215	210	223	227	230

Take Off Distance and Take Off Weight

In real life, take off weight for runway length, second segment and obstacle are presented in so called Individual Runway Tables or IRT's. Each runway on each airport an airline operates to will get 2 IRT's which will give you maximum take off weight for a given runway under given conditions.

In this manual however, doing this for the better part of several 100 airports would be way over the top! Apart from the fact that not many people would like to look up their respective TOW in a 1000 page book (or more, if I counted right) certainly not a lot of customers would be prepared to pay double the amount just for take off weight calculations on 2 aircraft.

So instead, we developed a table system that will still allow you to get sensible take off weights for any given runway, but in a more generalised manner. However, those of you who have access to real life IRT's, can use them without any problem with the aircraft of AS2.

Restrictions and deductions:

Runway length corrections for contaminated Runways:
Shorten actual runway length for calculation purpose by the factors given below.

WET: 100 meters
ICE: 900 meters

Obstacles: Use Obstacle Limit if obstacle is within 10'000 meters after runway end.

Crosswind Limitations: DRY/WET/DAMP Runway: 30 kts
ICE: 5 kts

Crosswind Table

Speed	10°	20°	30°	40°	50°	60°	70°	80°	90°
5 Kt	1	2	2	3	4	4	4	5	5
10 Kt	2	3	5	6	7	8	9	9	10
15 Kt	3	5	7	9	11	13	14	14	15
20 Kt	3	7	10	13	15	17	18	19	20
25 Kt	4	8	12	16	19	22	23	24	25
30 Kt	5	10	15	19	23	26	28	29	30
35 Kt	6	12	17	22	26	30	32	34	35

IRT 1 REFERENCE AIRPORT
Take Off Weight Table MD 83 / -219 Engines All weights ELEV 500 ft
FLAPS 11 Runway Length Limit / Obstacle Limit/2nd Segment Limit

RWY length	OAT °C						
HW/TW corr	-4	6	14	24	36	44	50
1500 m	121.3/123.7	119.3/123.8	117.7/123.8	115.9/123.9	109.3/116.3	103.3/108.6	99.7/103.1
TW- / HW+	960/290	940/280	940/280	930/270	880/260	830/250	800/230
2nd Seg.	159.1	159.2	159.2	159.2	148.2	137.6	129.9
1800 m	133.3/130.8	131.2/130.7	129.6/130.7	127.4/130.7	120.2/123.0	114.0/115.1	109.7/109.0
TW- / HW+	1010/290	990/280	980/280	960/280	920/260	870/250	840/240
2nd Seg.	159.1	159.2	159.3	159.2	148.2	136.7	129.9
2100m	144.0/137.9	141.7/137.9	139.9/137.8	137.6/137.7	129.9/129.3	123.2/121.3	118.6/115.2
TW- / HW+	1020/300	1000/300	980/290	970/290	930/270	890/260	850/250
2nd Seg.	159.1	159.2	159.2	159.2	148.2	137.6	129.9
2400m	153.8/144.4	151.4/144.4	149.5/144.4	147.0/144.3	138.6/135.4	131.6/126.9	126.6/120.5
TW- / HW+	1050/300	1030/400	1020/290	1000/290	930/270	890/260	860/250
2nd Seg.	159.1	159.2	159.2	159.2	148.2	137.6	129.9
2700m	162.7/149.8	160.2/149.8	158.1/149.7	155.6/149.6	146.5/140.2	139.2/131.4	133.9/125.0
TW- / HW+	1050/290	1040/300	1030/300	1010/290	940/280	890/240	860/250
2nd Seg.	159.1	159.2	159.2	159.2	148.2	137.6	129.9
3000m	170.7/154.0	168.2/154.0	166.0/154.0	163.5/153.9	154.0/144.3	145.8/135.0	140.7/128.2
TW- / HW+	1020/220	1040/300	1030/250	1020/270	970/290	870/270	870/230
2nd Seg.	159.1	159.2	159.2	159.2	148.2	137.6	129.9
3300m	176.0/156.7	173.9/156.8	172.3/156.7	170.6/156.7	161.2/146.9	152.3/137.4	146.3/130.4
TW- / HW+	800/190	860/220	910/250	980/200	990/290	890/290	800/270
2nd Seg.	159.1	159.2	159.2	159.2	148.2	137.6	129.9
3600m	180.8/158.0	179.0/158.0	177.3/158.2	175.2/158.3	167.9/148.4	159.3/138.5	152.4/131.5
TW- / HW+	720/50	760/60	710/90	770/80	990/100	1010/100	870/110
2nd Seg.	159.1	159.2	159.2	159.2	148.2	137.6	129.9

Use for airports from SL to 500 ft AMSL.

Maximum permissible obstacle gradient 1.5%

(Gradient is calculated as follows: $\frac{\text{obstacle height (m)}}{\text{distance from runway end (m)}} * 100$)

IRT 2 REFERENCE AIRPORT
Take Off Weight Table MD 83 / -219 Engines **All weights in LB** **2000 ft**
FLAPS 11 **Runway Length Limit / Obstacle Limit/2nd Segment Limit**

RWY length	OAT °C						
HW/TW corr	-4	6	14	24	36	44	50
1500 m	116.6/120.1	114.6/120.1	113.2/120.2	111.0/119.4	103.3/109.7	98.0/102.7	94.1/97.4
TW- / HW+	960/290	940/280	940/280	930/270	880/260	830/250	800/230
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124
1800 m	128.3/127.1	126.1/127.1	124.4/127.1	122.0/126.3	113.7/116.3	107.8/108.6	103.6/103.1
TW- / HW+	1010/290	990/280	980/280	960/280	920/260	870/250	840/240
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124
2100m	138.5/133.9	136.2/133.8	134.5/133.8	131.9/132.8	124.4/124.5	116.6/114.7	112.1/108.8
TW- / HW+	1020/300	1000/300	980/290	970/290	930/270	890/260	850/250
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124
2400m	148.0/140.0	145.4/139.9	143.6/139.9	140.8/138.9	131.3/128.1	124.5/120.0	119.9/114.0
TW- / HW+	1050/300	1030/400	1020/290	1000/290	930/270	890/260	860/250
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124
2700m	156.5/145.3	153.9/145.3	152.0/145.3	149.0/144.2	138.8/132.8	131.8/124.5	126.7/118.3
TW- / HW+	1050/290	1040/300	1030/300	1010/290	940/280	890/240	860/250
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124
3000m	164.5/149.3	161.8/149.3	159.9/149.3	156.6/148.2	145.4/136.4	138.5/127.7	133.2/121.6
TW- / HW+	1020/220	1040/300	1030/250	1020/270	970/290	870/270	870/230
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124
3300m	171.3/152.0	169.1/152.1	167.0/152.0	163.7/150.9	151.8/138.7	144.2/130.0	139.2/123.7
TW- / HW+	800/190	860/220	910/250	980/200	990/290	890/290	800/270
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124
3600m	176.6/153.6	174.0/153.5	172.5/153.6	170.4/152.3	158.8/140.0	149.8/131.1	144.6/125.0
TW- / HW+	720/50	760/60	710/90	770/80	990/100	1010/100	870/110
2nd Seg.	154.5	154.6	154.6	153.5	140.5	130.7	124

Use for airports from 500 ft AMSL to 2000 ft AMSL.

Maximum permissible obstacle gradient 1.5%

(Gradient is calculated as follows: $\dfrac{\text{obstacle height (m)}}{\text{distance from runway end (m)}} * 100$)

TAKE OFF WEIGHT CALCULATION TABLE TOW BY IRT

MD 83- 219 | Registration: | Flt Nr:

AIRPORT | RWY | DATE

Met Information: Wind:_____°/____Kt   OAT:______°C   QNH:____

Corrected Runway Length:________m   DRY: WET: ICE:

Wind: Maximum Crosswind :______ Kt   Head/Tailwind:_________kt

Crosswind: _________Kt

TOW vs RWY LENGTH: FLAPS 11

TOW 0 WIND

Head/Tailwind ______x______kt

Corrected TOW   A

ALL WEIGHTS IN LBS

TOW vs. OBSTACLE

TOW 0 WIND

Head/Tailwind ______x______kt

Corrected TOW   B

TOW vs 2nd SEGMENT: C

MAX PERMISSIBLE TOW

lowest of:

TOW vs RWY LENGTH	A	
TOW vs OBSTACLE	B	
TOW vs 2nd Segment	C	
MTOW		160'000

Permissible TOW

THIS SHEET TO BE FILLED IN BEFORE ANY TAKE OFF IS ATTEMPTED!

Sample Problem:

Runway 16 length as per airport chart: 2250 meters   Wind: 220/25 Kt
Runway condition: Wet.   Airport Elevation: 1416 ft.   OAT 15 ° C QNH 1013

Find: Maximum Permissible TOW.
Step 1: Find Corrected Runway Length: 2250 Meters - 100 Meters for Wet runway.
Step 2: Find Head or Tailwind using the table on page

TAKE OFF WEIGHT CALCULATION TABLE   TOW BY IRT

MD 83- 219	Registration:		FltNr:
AIRPORT Sample		RWY 16	DATE

Met Information: Wind:_220_°/_25_kt   OAT:__15___°C   QNH:1013

Corrected Runway Length:__2150__m   DRY: WET: x   ICE:

Wind: Maximum Crosswind :__30__ Kt   Head/Tailwind:___12____kt

Crosswind: ___22____kt

TOW vs RWY LENGTH: FLAPS 11

TOW 0 WIND		_134'500_
Head/Tailwind _12___x__290_kt		4'280
Corrected TOW	A	138'780

ALL WEIGHTS IN LBS

TOW vs. OBSTACLE

TOW 0 WIND		_133'800_
Head/Tailwind __12__x__290_kt		___4'280
Corrected TOW	B	138'080

TOW vs 2nd SEGMENT:	C	154'600

MAX PERMISSIBLE TOW

lowest of:

TOW vs RWY LENGTH	A	138'780		
TOW vs OBSTACLE	B	138'080		
TOW vs 2nd Segment	C	154'600	Permissible TOW	
MTOW		160'000		138'080

You will find that take offs flown with maximum take off weight are very rare indeed. For the Career Airports in AS2, you will find some indications on which table (1 or 2) to use and which have obstacles below.

Airport	RW	Obst	IRT	Airport	RW	Obst	IRT	Airport	RW	Obst	IRT
Amsterdam	1L	y	1	Edinburgh	7	y	1	Oslo	01L	y	1
EHAM	1R	y	1	EGPH	13	y	1	ENGM	01R	y	1
AMS	6	y	1	EDI	25	y	1	GDM	19L	y	1
	9	y	1		31	y	1		19R	y	1
	14	y	1	Frankfurt	07L	y	1	Paris CDG	08L	y	1
	19R	y	1	EDDF	07R	y	1	LFPG	08R	y	1
	19L	y	1	FRA	25L	y	1	CDG	9	y	1
	24	y	1		25R	y	1		26L	y	1
	27	y	1		18	y	1		26R	y	1
Athen	15L	y	1	Geneva	5	y	2		27	y	1
LGAT	15R	y	1	LSGG/GVA	23	y	2	Rome	7	y	1
ATH	33R	y	1	Helsinki	4	y	1	LIRF	16R	y	1
	33L	y	1	EFHK	15	y	1	FCO	16L	y	1
Barcelona	2	y	1	HEL	22	y	1		25	y	1
LEBL	20	y	1		33	y	1		34L	y	1
BCN	7	y	1	Keflavik	4	y	1		34R	y	1
	25	y	1	BIKF	11	y	1	Salzburg	16	y	2
Berlin Tegel	08L	y	1	KFL	20	y	1	LOWS/SZG	34	y	2
EDDT	08R	y	1		29	y	1	Shannon	6	y	1
TXL	26R	y	1	Lisboa	3	y	1	EINN	13	y	1
	26R	y	1	LPPT	17	y	1	SNN	24	y	1
Boston	4R	y	1	LIS	21	y	1		31	y	1
KBOS	4L	y	1		35	y	1	Sondrestrom	10	y	1
BOS	9	y	1	L-Gatwick	08L	y	1	BGGS	28	y	1
	15R	y	1	EGGK	08R	y	1	Stockholm	1	y	1
	15L	y	1	LGW	26L	y	1	ESSA	8	y	1
	22R	y	1		26R	y	1	ARN	19	y	1
	22L	y	1	L-Heathrow	09L	y	1		26	y	1
	33L	y	1		09R	y	1	Vienna	11	y	2
	33R	y	1		23	y	1	LOWW	16	y	2
Brussels	2	y	1		27L	y	1	VIE	29	y	2
EBBR	07R	y	1		27R	y	1		34	y	2
BRU	07L	y	1	Madrid	15	y	2	Zürich	10	y	2
	20	y	1	LEMD	18L	y	2	LSZH	14	y	2
	25R	y	1	MAD	18R	y	2	ZRH	16	y	2
	25L	y	1		33	y	2		28	y	2
Cologne	7	y	1		36R	y	2		32	y	2
EDDK	14R	y	1		36L	y	2		34	y	2
CGN	14L	y	1	Malaga	14	y	1	Gander	4	y	1
	25	y	1	LEMG/AGP	32	y	1	CYQX	9	y	1
	32R	y	1	Manchester	06L	y	2	YQX	13	y	1
	32L	y	1	EGCC/MAN	24R	y	2		20	y	1
Copenhagen	04L	y	1	Milan Linate	18L	y	1		27	y	1
EKCH	04R	y	1	LIML/LIN	36R	y	1		31	y	1
	12	y	1	Munich	08L	y	2				
	22L	y	1	EDDM	08R	y	2				
	22R	y	1	MUC	26L	y	2				
	30	y	1		26R	y	2				
Dublin	10	y	1	New York	04L	y	1				
EIDW	11	y	1	KJFK	04R	y	1				
DUB	16	y	1	JFK	13R	y	1				
	28	y	1		13L	y	1				
	29	y	1		22L	y	1				
	34	y	1		22R	y	1				
Dusseldorf	5L	y	1		31R	y	1				
EDDL	5R	y	1		31L	y	1				
DUS	23	y	1								

Climb

The following table will give you an overview over time / fuel / distance to climb. Conditions are:

- Standard 250/290 KIAS / M 0.75 climb.
- ISA conditions
- Climb from sea level.

MD 83 -219 Time Fuel and Distance to Climb table.

	TAKE OFF WEIGHT							
FL/TOW	90	100	110	120	130	140	150	160
370	64/11/2360	73/12/2690	84/14/3050	97/16/3450				
350	57/10/2240	65/11/2540	75/13/2870	85/14/3240	97/16/3640			
330	51/9/2130	59/10/2420	67/12/2720	76/13/3060	86/15/3420	97/17/3830		
310	47/8/2030	53/10/2420	60/11/2580	68/12/2890	77/14/3230	87/15/3600	98/17/4020	
290	42/8/1930	48/9/2180	55/10/2450	62/11/2740	69/12/2740	77/14/3390	87/16/3780	98/17/4200
270	37/7/1800	42/8/2030	48/9/2280	54/10/2540	60/11/2830	67/12/3130	75/14/3480	84/15/3850
250	33/6/1670	37/7/1890	42/8/2110	47/9/2350	52/10/2610	57/11/2890	65/12/3200	72/14/3530
230	28/6/1550	32/7/1750	36/7/1960	40/8/2170	45/9/2410	50/10/2660	56/11/2940	62/12/3240
210	25/5/1430	28/6/1610	31/7/1800	35/7/2000	39/8/2220	43/9/2440	48/10/2690	53/11/2960
190	21/5/1320	24/5/1490	27/6/1660	30/7/1840	34/7/2030	37/8/2240	41/9/2460	45/10/2700
170	18/4/1210	21/5/1360	23/5/1520	26/6/1680	29/7/1860	32/7/2040	35/8/2250	39/9/2460
150	16/4/1100	18/4/1240	20/5/1380	22/5/1530	24/6/1690	27/6/1860	30.07.40	33/8/2230
100	10/3/850	11/3/950	13/4/1060	14/4/1170	16/4/1290	17/5/1410	19/55/1550	21/6/1690
50	5/2/540	5/2/600	6/2/670	7/2/730	8/3/810	8/3/880	9/3/960	10/3/1050

Sample: To climb from SL to FL 290 at 140'000 lbs.: Find: 77 NM, 14 Minutes, Fuel used 3390 lb.

Service ceiling and single engine climb

The following speeds are used in a single engine climb or in climb near the service ceiling.

Service Ceiling and 1 Engine Out Climb Speeds

Weight (1000 lb.)	90	100	110	120	130	140	150	160
Speed (KIAS)	173	183	191	200	208	215	223	230

Drift Down Speeds

Drift Down Speeds

Weight (1000 lb.)	90	100	110	120	130	140	150	160
Speed (KIAS) >FL100	204	215	225	236	246	256	265	275
Speed (KIAS) <FI100	173	182	290	200	208	215	223	230

AIRLINE SIMULATOR 2

Descent

Normal Descent

FL at start of descent FL at end of descent

	250	200	150	100	80	60	40	20	SL
370	11/83/750	13/96/794	15/110/884	18/125/906	21/136/935	21/136/966	25/148/1268	25/148/1268	26/154/1310
350	9/65/575	11/78/622	13/92/670	16/107/734	17/113/763	18/118/791	19/124/825	22/130/1093	24/136/1135
330	6/46/392	8/60/439	10/73/487	13/89/551	14/94/580	16/100/608	17/105/642	20/112/911	21/117/952
310	4/28/201	6/41/245	8/55/295	11/70/357	12/76/386	13/81/417	14/87/450	17/93/719	19/99/761
290	02/12/33	4/25/77	6/38/128	9/54/192	10/60/218	11/65/249	12/71/282	15/77/551	16/83/593
270	1/6/18	3/19/62	5/33/110	8/48/174	9/54/203	10/59/231	11/65/267	14/71/534	16/77/575
250		2/14/46	4/27/95	7/43/159	8/48/185	9/54/216	11/59/249	13/66/518	15/71/560
200			2/13/49	5/29/112	6/34/141	7/40/170	9/46/203	11/52/472	13/58/514
150				3/16/64	4/21/93	5/27/121	6/32/154	9/39/423	11/44/465
100					1/6/29	2/11/57	4/17/90	7/23/359	8/29/401

Time / Minutes / Distance to descent.

Holding

Holding below FL 140 is flown at VP clean. Expect fuel flow of about 6000 lbs./hr to 7500 lbs./hr (2 engines) for 120'000lbs to 160'000 lbs. respectively.

Holding Speeds

Below FL 140 use Vp Clean

Weight (1000 lb.)	90	100	110	120	130	140	150	160
Speed (KIAS) >FL250	205	220	225	240	245	255	265	270
Speed (KIAS) <Fl250	195	207	215	230	235	245	255	260

Landing

Landing Weight

FLAPS 28	ISA conditions		Dry Runway		No Wind
			Corrected Field Length		
Elevation	1300	1500	1650	1850	2000
0	89.0	116.5	124.3	132.2	140.0
2000	N/A	111.3	119.5	127.8	136.0
4000	N/A	106.0	114.7	123.3	132.0

FLAPS 40	ISA conditions		Dry Runway		No Wind
	Corrected Field Length				
Elevation	1300	1500	1650	1850	2000
0	89.0	126.5	144.3	162.2	180.0
2000	N/A	118.9	135.2	151.6	168.0
4000	N/A	111.2	126.1	141.1	156.0

Corrections:

Wind:

Headwind:	Increase Corrected Field Length by 50 meters per 5 Kt headwind.
Tailwind:	Decrease Corrected Field Length by 100 meters per 5 Kt Tailwind. Tailwind Limit of 10 Kt.

Surface Conditions:

Dry Runway:	Crosswind Limitation 30 kts.
Wet Runway:	Decrease Corrected Field Length by 300 meters. Crosswind Limitation 30 kts
Icy Runway:	Decrease Corrected Field Length by 750 meters. Crosswind Limitation 5 kts.

Approach Speeds

The following speeds are to be used for approach in normal configuration. Please observe maximum landing weight limits.

Normal Approach Speeds

Flaps	Slats	Speed	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
0		Vp clean	195	200	207	211	215	221	225	230	234	239	241	259	253	257	260
0	Take-Off	Vp0	153	156	160	165	168	173	176	180	183	187	190	194	198	200	203
15	Take-Off	Vp15	140	143	147	151	155	159	162	165	168	171	175	178	181	184	186
28	Land	Vp28	122	125	129	132	135	138	142	144	148	149	153	155	158	161	163
28	Land	Va28	119	121	125	128	130	135	136	139	141	144	147	149	152	154	156
40	Land	Va40	115	118	121	124	126	130	131	134	137	139	142	144	147	149	151

Remark: The term Va28/Va40 may seem confusing to some of the more experienced pilots, as Va as such is normally used as a maneuvering speed. Here, it merely reflects the term „Approach Speed". As it was consistent in all my MD 83 docs, I decided to keep it on for this manual.

Flight Planning

Flight Level Selection

For most economical use of the aircraft, flight levels for cruise flight should be chosen based on TOW and on the total distance of flight. The following table give you an indication on which FL to use.

Flight Level Selection vs Take Off Weight

TOW (1000 lb.	120	130	140	150	160
Normal Cruise	370	350	330	320	300
High Speed Cruise	370	340	330	310	300

If a step climb is needed, you can use the above table to determine at what weight the step climb has to be initiated. If the final level should be 350 for example, step climb can be started once the weight has decreased to 130'000 lbs. in normal cruise.

Flight Level Selection vs ESAD

Distance	100	150	200	250	300
Max FL	150	200	290	350	370

On short distances, climb to very high altitudes does not make sense. The table above gives you some indication on which FL to use for comparatively small distances. The distances are given in ESAD, that means they can be used as still air (no wind) distances or with wind corrections as outlined below:

$$ESAD = Ground\ Distance \cdot \frac{TAS}{TAS \pm Wind\ Component}$$

Fuel (Trip, Alternate & Reserve)

Taxi Fuel

The standard fuel for starting up the engines and for taxi is determined as 200 KGs / 440 lb.

Cruise

NORMAL CRUISE

LONG RANGE CRUISE / 290 KIAS

Trip Fuel in lb.

ESAD (NM)	100	150	200	250	270	290	310	330	350	370
100	2800	2690								
150	3836	3638	3549							
200	4872	4586	4409	4343	4321	4299				
250	5930	5534	5269	5115	5071	5026	5004			
300	6967	6482	6107	5908	5820	5754	5710	5622	5379	5379
350	8025	7430	6967	6702	6592	6504	6437	6327	6085	6085
400	9083	8377	7826	7496	7341	7231	7143	7033	6746	6746
450	10141	9348	8686	8289	8113	7981	7870	7716	7341	7319
500	11199	10318	10273	9061	8862	8708	8576	8377	7937	7892
550	12236	11249	10760	9858	9622	9445	9295	9085	8609	8563
600	13287	12201	11677	10647	10380	10181	10010	9775	9246	9189
650	14337	13153	12593	11436	11138	10917	10726	10465	9883	9815
700	15388	14105	13509	12225	11896	11654	11441	11155	10520	10441
750	16438	15057	14426	13013	12654	12390	12157	11845	11157	11067
800	17489	16009	15342	13802	13413	13126	12872	12535	11795	11693
850	18539	16961	16259	14591	14171	13862	13588	13225	12432	12319
900	19590	17913	17175	15380	14929	14598	14303	13915	13069	12945
950	20640	18865	18092	16169	15687	15335	15019	14605	13706	13572
1000	21691	19817	19008	16958	16446	16071	15735	15296	14343	14198
1050	22741	20769	19925	17747	17204	16807	16450	15986	14980	14824
1100	23792	21721	20841	18536	17962	17543	17166	16676	15617	15450
1150	24842	22673	21758	19325	18720	18279	17881	17366	16255	16076
1200	25893	23625	22674	20114	19478	19015	18597	18056	16892	16702
1250	26943	24577	23591	20903	20237	19752	19312	18746	17529	17328
1300	27994	25529	24507	21692	20995	20488	20028	19436	18166	17954
1350	29044	26481	25424	22481	21753	21224	20743	20126	18803	18580
1400	30095	27433	26340	23270	22511	21960	21459	20816	19440	19206
1450	31145	28385	27257	24058	23270	22696	22174	21506	20077	19833
1500	32195	29337	28173	24847	24028	23433	22890	22196	20714	20459
1550	33246	30289	29090	25636	24786	24169	23606	22886	21352	21085
1600	34296	31241	30006	26425	25544	24905	24321	23576	21989	21711

1650	35347	32193	30923	27214	26302	25641	25037	24266	22626	22337
1700	36397	33145	31839	28003	27061	26377	25752	24956	23263	22963
1750	37448	34097	32756	28792	27819	27113	26468	25646	23900	23589
1800	38498	35049	33672	29581	28577	27850	27183	26336	24537	24215
1850	39549	36001	34589	30370	29335	28586	27899	27026	25174	24841
1900	40599	36954	35505	31159	30094	29322	28614	27716	25811	25468
1950	41650	37906	36422	31948	30852	30058	29330	28406	26449	26094
2000	42700	38858	37338	32737	31610	30794	30046	29096	27086	26720

High Speed Cruise
330 Kt IAS / M 0.78

Trip Fuel in lb.

ESAD (NM)	100	150	200	250	270	290	310	330	350
100	2888								
150	3968	3726	3660						
200	5071	4718	4564	4519	4475	4431			
250	6173	5710	5467	5401	5291	5225	5159		
300	7275	6702	6371	6261	6107	5997	5908	5423	5688
350	8377	7716	7275	7143	6944	6790	6680	6570	6437
400	9480	8708	8179	8003	7760	7562	7430	7297	7165
450	10582	9722	9105	8885	8598	8355	8179	8003	7804
500	11684	10714	10031	9744	9414	9149	8929	8686	8422
550	12809	11728	10957	10626	10251	9943	9700	9436	9171
600	13893	12719	11846	11494	11069	10720	10450	10201	9849
650	14996	13719	12757	12365	11895	11506	11206	10946	10535
700	16098	14720	13669	13237	12720	12292	11962	11691	11221
750	17200	15720	14580	14108	13546	13079	12717	12436	11907
800	18303	16721	15491	14979	14371	13865	13473	13180	12592
850	19405	17721	16402	15851	15197	14651	14229	13925	13278
900	20507	18722	17313	16722	16022	15438	14985	14670	13964
950	21609	19722	18225	17593	16847	16224	15741	15415	14650
1000	22712	20723	19136	18465	17673	17010	16497	16160	15336
1050	23814	21723	20047	19336	18498	17797	17253	16905	16022
1100	24916	22724	20958	20207	19324	18583	18008	17649	16708
1150	26019	23724	21870	21079	20149	19369	18764	18394	17394
1200	27121	24725	22781	21950	20974	20156	19520	19139	18080
1250	28223	25725	23692	22821	21800	20942	20276	19884	18766
1300	29326	26726	24603	23693	22625	21728	21032	20629	19452
1350	30428	27727	25515	24564	23451	22514	21788	21374	20138
1400	31530	28727	26426	25435	24276	23301	22544	22118	20824
1450	32632	29728	27337	26307	25101	24087	23299	22863	21510
1500	33735	30728	28248	27178	25927	24873	24055	23608	22196
1550	34837	31729	29160	28049	26752	25660	24811	24353	22882
1600	35939	32729	30071	28921	27578	26446	25567	25098	23568
1650	37042	33730	30982	29792	28403	27232	26323	25843	24254
1700	38144	34730	31893	30663	29229	28019	27079	26587	24939
1750	39246	35731	32804	31535	30054	28805	27835	27332	25625
1800	40349	36731	33716	32406	30879	29591	28591	28077	26311
1850	41451	37732	34627	33277	31705	30378	29346	28822	26997
1900	42553	38732	35538	34149	32530	31164	30102	29567	27683
1950	43655	39733	36449	35020	33356	31950	30858	30312	28369
2000	44758	40733	37361	35891	34181	32736	31614	31057	29055

AIRLINE SIMULATOR 2

Flight Time Normal Cruise

Flight Time Minutes

ESAD (NM)	100	150	200	250	270	290	310	330	350	370
100	22	21								
150	31	29								
200	40	38	36	36	36	36				
250	49	47	44	43	43	42	42	42		
300	58	55	52	50	50	49	49	49	49	49
350	67	63	60	58	58	56	56	56	56	56
400	75	71	68	65	65	63	62	63	63	63
450	85	50	76	72	70	68	69	70	70	70
500	94	88	83	80	79	77	76	76	77	77
550	103	86	91	87	86	83	83	83	84	84
600	112	93	99	94	93	90	89	90	91	91
650	121	100	107	102	100	96	96	97	98	98
700	130	106	115	109	107	103	103	104	105	105
750	139	113	123	116	114	110	110	111	112	112
800	148	120	131	124	121	117	116	118	119	119
850	157	127	139	131	128	123	123	124	126	126
900	165	134	147	138	135	130	130	131	133	133
950	174	141	155	146	142	137	137	138	140	140
1000	183	148	162	153	149	144	143	145	147	147
1050	192	155	170	160	156	150	150	152	154	154
1100	201	161	178	168	163	157	157	159	161	161
1150	210	168	186	175	170	164	164	166	168	168
1200	219	175	194	182	178	171	170	172	175	175
1250	228	182	202	190	185	177	177	179	182	182
1300	237	189	210	197	192	184	184	186	189	189
1350	246	196	218	204	199	191	190	193	196	196
1400	255	203	226	211	206	198	197	200	203	203
1450	264	210	234	219	213	204	204	207	210	210
1500	273	217	241	226	220	211	211	214	217	217
1550	282	223	249	233	227	218	217	220	224	224
1600	291	230	257	241	234	225	224	227	231	231
1650	300	237	265	248	241	231	231	234	238	238
1700	309	244	273	255	248	238	238	241	245	245
1750	318	251	281	263	255	245	244	248	252	252
1800	327	258	289	270	262	252	251	255	259	259
1850	336	265	297	277	269	258	258	262	266	266
1900	345	272	305	285	277	265	265	268	273	273
1950	354	278	312	292	284	272	271	275	280	280
2000	363	285	320	299	291	279	278	282	287	287

For High Speed Cruise deduct about 6 minutes.

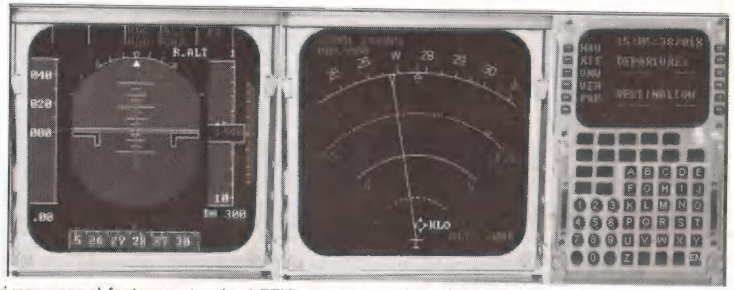
Alternate Fuel:
To calculate diversion fuel, use the tables above.

MD 88 - Difference Guide

The MD 88 modelled in Airline Simulator 2 is aerodynamically identical to the MD 83. It has, of course a different cockpit and therefore differences in operation to the MD 83. The following chapter will make you familiar with these issues and permit you to operate the MD 88 as an EFIS alternative to the MD 83.

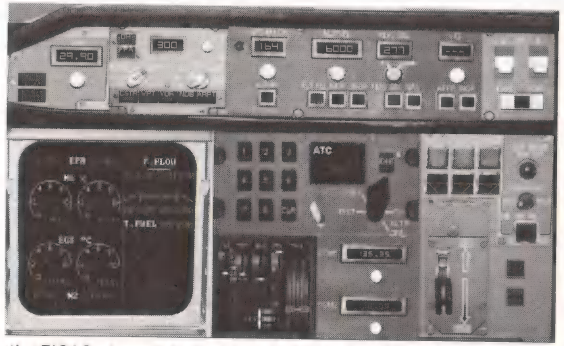
Note to former 3 DAGS users:

The cockpit of the MD 83 is largely identical to the 3DAGS EFIS cockpit you are familiar with from flying the 767 and A320 in ATP. That is intentional. The whole idea was to give you a familiar cockpit you can start AS2 with. Most functions from 3DAGS still work, but there is a bunch of others added to it.



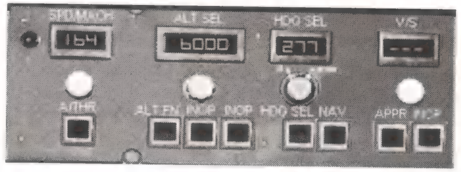
The MD 88 primary panel features standard EFIS screens, and the NOMIS 2900 V FMC.
The Primary Flight Display on the left features Flight Director, Horizon Sphere, Speed Tape to the left, Altitude Tape to the right and VSI to the far right. On the bottom, a compass indication with heading bug can be seen. The indications for Autopilot modes are identical to the ones displayed in the MD 83 Autopilot indicator.
The Navigation Display features a 75° forward view only. NAV 1 and 2 are represented with RMI needles and NAV 2 will display a diamond shaped CDI at the bottom when a VOR or LOC signal is received. The ND is controlled via its control panel on the secondary panel.

For operation of the FMC, please refer to the FMC chapter.



On the secondary panel, the EICAS gives all indications of engine and fuel parameters, as well as flap indication. In the glareshiled, the EFIS control panel allows selection of various details, such as WPT (Waypoints), VOR's, NDB's and Airports. Also the range indicator is available.
ATC transponder, Gear lever and the standard control indicator are the other elements of the secondary panel. They work conventionally.

The Autopilot panel is the biggest difference to the MD83. If you are familiar with 3DAGS, you are right at home. If not, no problem, it is easy to learn.



There are 4 windows in the autopilot control panel. The left window allows input of speed, the middle left one of altitude, the middle right one of heading and the right one of vertical speed. Below the windows, mode control buttons allow the mode selection.

The philosophy of the Autopilot corresponds to the 3DAGS A320 AP and uses the same control commands.

The Autopilot is switched on and off by pressing SHIFT Z. The roll modes are controlled by SHIFT X, toggling HDG SEL, NAV 1 hold, NAV 2 hold, and LNAV. The Altitude mode is toggled with SHIFT C.

In addition, SHIFT W toggles FD on and off. The following modes are available in addition:

Open Climb/Descend Mode: In this mode the autopilot will set a fixed thrust (climb 1.90 EPR, descent idle), and maintain selected speed (speed window of autopilot) by pitch (adjusting vertical speed). Open Climb/Descent is initiated by dialling the new altitude into the altitude window, then pressing <SHIFT><ENTER>. If autothrottle has been activated by that time, the mode is set to thrust mode (if autothrottle was not active, the responsibility for applying proper thrust is left to the pilot). On reaching the selected altitude, the autopilot reverts into altitude hold mode automatically, and reverts to speed hold mode on autothrottle if autothrottle was engaged.

TOGA Mode: by pressing <SHIFT><D> maximum thrust is activated (EPR 2.01) and autothrottles get engaged. If the autopilot was in autoapproach mode, the autopilot also engages open climb to the dialled altitude and activates heading hold.

Heading Bug: as known before, turning the heading bug with heading bug enabled turns the plane. The plane will do a maximum bank of 30 degrees.

VOR tracking: When NAV tracking is switched on, the autopilot goes into armed mode, following the previous heading until CDI comes alive. On CDI coming alive, the autopilot goes into capture mode, and turns the plane to intercept the radial. Once the radial has been captured the autopilot goes into track mode.

LOC tracking: When a localizer is tuned and NAV tracking or Autoapproach is enabled, the autopilot goes into armed mode and maintains previously set heading until CDI comes alive. On CDI coming alive, the autopilot goes into capture mode, and turns the airplane to intercept the localizer beam. When established on localizer beam, the autopilot switches into track mode. Note: NAV tracking enables tracking localizer on NAV2, while autoapproach uses NAV1.

The autoapproach couples to _NAV1_ (displayed in PFD) and no longer to NAV2, leaving NAV2 for other navigation purposes (e.g. approach navigation, missed approach tracking).

When engaged, both NAV1 LOC tracking and glideslope tracking get armed. For LOC tracking see above. As long as the glideslope indicator is inactive, the autopilot will maintain the present altitude, no matter whether the needle is at upper or lower end of scale. When the needle gets within +/- 1 dot, the autopilot will adjust vertical speed to gradually descend the plane according to glideslope indication. The autopilot is capable of a full CATIIIb handling.

If TOGA has been activated during approach, the approach mode is cancelled, the autopilot will maintain present heading, apply maximum thrust and initiate an open climb to the preselected altitude in the altitude window. It is left to the pilot, whether to idle thrust and discontinue missed approach (remember: spoilers are out probably and autobrake has been initiated!), or allow the plane to get up into the air again (spoilers down, disengage auto brakes).

LNAV:

LNAV requires both airports and the waypoint list completed, with at least one waypoint defined in between. No other provisions needed to get LNAV working. You can edit the route any time, while LNAV is working. If your current active waypoint is modified (by inserting a waypoint or deleting the active one), LNAV will go into "direct" mode and head directly to inserted or next waypoint (note, that previous waypoints are still available in FMC, but are not looked at). When LNAV gets engaged, it will head directly towards the active waypoint, too.

The waypoint list is verified all time, even with LNAV off. So waypoints are switched, when you overfly the waypoints even manually or in other autopilot modes. Overflying means, being within 2.5 nm at low speed (<250 KTAS), and being close to 10 miles at high speeds (>400 KTAS). If you fail to overfly a waypoint properly, the switch will not take place, and the FMC might take you back to that waypoint, if you activate LNAV later on.

After passing the last defined waypoint the plane will stay on the radial until LNAV is turned off and other action is taken. At this time the FMC will not take you along the green line to the waypoint being automatically inserted to mark 10nm ahead of threshold on localizer.

Keyboard commands:

SHIFT+E:	ND range up
SHIFT+D:	TOGA
B:	Set parking brake (release with normal braking key M)
SHIFT Z:	Toggles AP on, off
SHIFT-X:	Cycles through none, heading bug, NAV2 and LNAV
SHIFT C:	Toggles ALT Function on / off
SHIFT+ENTER:	initiate Level Change
SHIFT+S:	CAT IIIb autolanding
SHIFT+W:	Flight director enabled
SHIFT-5	Flips HSI switch to link to NAV or FMS
CTRL-Cursor Left/Right:	Aileron Trim
CTRL-Cursor 5	Centre Aileron Trim
CTRL-,/CTRL-.	Rudder Trim
CTRL-L	Centre Rudder Trim

Your career with Airline Simulator 2

Airline Simulator 2 is more than a pure flight simulator, it also provides you with an unique feature, the Flight Assignments system. This system allows ATC controlled flights between any of 26 primary airports. There are three different ways of selecting flights, Single Assignments, where you can define most of the parameters, Auto Flight, where the Simulator flies itself from airport to airport or Career Assignments, which give you the challenge of developing your flying skills and gaining experience, which will be assessed and increasingly challenged as you progress through the pre-programmed assignments.

If you join an airline in real life, you will start out as a second or first officer and then over a period of time, move up through the ranks to become an airline Captain. In Airline Simulator 2, you will be a captain from the beginning, usually because you are the only one there to fly the aircraft.... So, seriously for a moment, Airline Simulator 2 includes a full set of career assignments which you can attempt as you feel your skill levels have developed enough to be able to cope with them.

A flight or career assignment is launched via the F1 menu. In it, you will see the three flight modes which will provide you with ATC guided flights between the 26 primary airports. The first option is Automatic Flight. This option will execute the complete flight fully automatically for you to observe, in the same manner as the demonstration flight you see when you first start the program. You can sit back and relax while the program flies from the starting point to the destination. This mode is intended for beginners who wish to observe the operation of the aircraft in a routine ATC flight. The next option is Single Assignment. A single assignment is a ATC controlled flight, much like the automatic flight. You can select starting and arrival airport yourself or select a career assignment. The Single Assignment option will not affect your career, but give you the possibility to practice flights at your convenience. It also has an interface to Airline.Drv, a service program for virtual airlines. For more information on Airline.Drv, please refer to the respective chapter further on in this book.

The career assignment option will open the door to an airline like career. Once you start this option for the first time, you are asked to enter a pilot name. If you have not previously flown career assignments, you have to enter your name. If it does not fit into the box, abbreviate it as convenient, but be sure to remember it. You can use more than one career name, for example have separate career files for you, your wife and other family members who may want to follow a career. Each career flight is entered into the log book and you can review your career standing at any time by using option 3. This will show you the logbook and your present career standing, how much virtual money you have made and so on.. Option 2 will start your next career flight, normally No. 1 for a first time user.

Each career flight is evaluated on completion. You will be derated for violating any of rules and regulations, for breaking speed limits or for flying inefficiently. I have marked the most important items below, to give you an idea on how the evaluation works. The aim is to be above 70% on all regulations.

Your career will start as a first officer on the MD83. As you progress, you will be assigned more and more demanding flights on all 3 aircraft. When you have reached a certain standard, AS2 will ask you to take a type rating check flight on one of the aircraft. If you pass that check flight, you will be awarded the type rating for that aircraft and thus more virtual pay. By the end of the assignment system, you will be offered the ATPL check ride, and have reached the highest possible license in the virtual airline of Airline simulator 2.

Flying an assignment

To fly a single assignment, Press F1 and then choose option 3, single assignment. You will be presented with a succession of menu options which let you specify the following parameters:

- Departure Airport
- Destination Airport
- Aircraft
- Weather.

You may also choose a career assignment from the assignment list, in which case the parameters are set for you.

Once the assignment starts, you will have to follow the ATC commands and fly the aircraft under IFR rules from the starting point to the destination. At the end of the assignment, you will be presented with an evaluation.

To fly a Career Assignment, press F1 and choose option 4. You will be asked to enter the pilots name under which the career is saved. If you are new to career assignments, you will need to enter the name first. You can also keep several different careers going by saving logbooks under different names. The logbook will record all career flights and keep track of your career standing.

The career assignment works the same way as the single assignment, but it is recorded in your logbook.

Career assignments are flown in a numerical order, starting with 1 and ending with 96. The assignments will become more and more demanding as you go on.

A good way of seeing how the assignments work is to do an Automatic Flight, which will in general run the assignment fully automatically.

Using ATC in the Assignments.

The main attraction in flying assignments is the interaction and control provided by ATC. Each assignment will guide you from the start to destination. You first start out at the tarmac of the origin airport. Tune one of your COM radios to the ATIS of the airport (see the airport chart for frequency.). Note the runway in use, altimeter setting and wind readings. You are now ready to contact clearance delivery. Deselect the ATIS and set the CLR frequency. To log in with delivery press CTRL X. Now, your clearance will be read out. Note again the runway, route, squawk and altitude restriction. Set the Squawk code on the Transponder, the cleared altitude in the altitude preselector and the runway heading on the heading bug of the HSI. You have to "read back„ all the received messages by pressing CTRL ENTER. Once you have received your clearance, contact Ground for taxi instructions. Ground will send you off to the take off runway. Use your airport chart to find the runway. If your assigned runway is the default runway of the airport, you can move to that runway instantly by pressing the automatic taxi key (~).

When you are ready for departure, contact the tower. Tower will subsequently clear you for line up and take off. Unless you have used the taxi short cut key, make sure that you hold clear of the active runway until line up clearance is given. Once cleared for take off, go ahead and start your take off roll. It is quite important to keep up with the climb schedule. You must reach 220 kts or above by 3000 ft AGL, or you will be derated. Once in the air, you will be handed off to departure control, who will give you radar vectors to the first waypoint. You must check the Ident of each Navaid that you use, and you will be downrated if you do not check them. Once you have reached it, you will be subsequently handed off to the en-route centres who will continue to guide you along your cleared route. Maintain 250 kts below 10'000 ft and then continue according to the climb schedule.

At the top of descent, you will be cleared to 10'000 ft. It is time to check the ATIS for your destination. Shortly afterwards you will be handed off to approach control for the destination airport. Approach control will vector you around to intercept the ILS approach for the active runway. Follow the ILS and land. Once you have stopped the aircraft, the evaluation will appear.

Below, find a sample transcription of a career flight. Note that the real assignment will most probably be different, this is just to give you an idea. It is important to ALWAYS respond to an ATC message, by either acknowledging it, or asking the controller to repeat it. If at any stage in the flight it seems as it ATC has been ignoring you, ask for a repeat of the last message, and acknowledge it, the most likely reason for the lack of messages is that you have missed an earlier response to ATC.

Sample flight Zürich - Geneva.

The items in italics are the response that you generate with the keypress you make
Waypoint names will be spelled phonetically, so ATC will say Romeo Echo Victor Lima India for REVLI.

Entry	**Radio Call**
CTRL X	*ZRH Clearance Delivery Air Nomis Flight 123 request clearance to GVA*
	Air Nomis Flight 123 cleared to Geneva via radar vectors to FRI
	G5 REVLI G5 SPR climb and maintain 8000 ft expect FL110 10 Minutes after departure, Departure Frequency 118.00 sqawk 1234
CTRL ENTER	*roger Air Nomis flight 123*

Change to apron frequency 121.75

CTRL TAB	*ZRH ground Air Nomis flight 123 with you request taxi for take off*
	Air Nomis flight 123 taxi to runway 16

Change to Tower frequency 118.30

CTRL TAB	*ZRH tower Air Nomis flight 123 with you*
	Air Nomis flight 123 line up and wait runway 16
CTRL ENTER	*roger Air Nomis flight 123*
	Air Nomis flight 123 fly hdg 160 cleared for take off runway 16
CTRL ENTER	*roger Air Nomis flight 123*
	Air Nomis flight 123 contact departure on 118.00
CTRL ENTER	*roger Air Nomis flight 123*

Change to 118.00

CTRL TAB	*Departure Air Nomis flight 123 with you*
	Air Nomis flight 123 fly heading 300
CTRL ENTER	*roger Air Nomis flight 123*
	Air Nomis flight 123 fly heading 280
CTRL ENTER	*roger Air Nomis flight 123*
	Air Nomis flight 123 proceed direct to FRI them resume own navigation
CTRL ENTER	*roger Air Nomis flight 123*
	Air Nomis flight 123 climb to 11000 ft.
CTRL ENTER	*roger Air Nomis flight 123*

	Air Nomis flight 123 contact ZRH ctr at 135.65
CTRL ENTER	*roger Air Nomis flight 123*

Change to 135.65

CTRL TAB	*ZRH ctr Air Nomis flt 123 with you*
	Air Nomis flight 123 altimeter 29.90
CTRL ENTER	*roger Air Nomis flight 123*

Get ATIS

	Air Nomis flight 123 contact GVA approach on 120.30
CTRL ENTER	*roger Air Nomis flight 123*

Change to 120.30

CTRL TAB	*GVA approach Air Nomis flight 123 with you*
	Air Nomis flight 123 descend to 7000 ft
CTRL ENTER	*roger Air Nomis flight 123*
	Air Nomis flight 123 turn left heading 230 until intercepting localizer runway 23 cleared for ILS approach runway 23
CTRL ENTER	*roger Air Nomis flight 123*
	Air Nomis flight 123 contact GVA tower on 118.70
CTRL ENTER	*roger Air Nomis flight 123*

Change to 118.70

CTRL TAB	*Geneva Tower Air Nomis flight 123 with you*
	Air Nomis flight 123 cleared to land runway 23
	Air Nomis Contact Ground on 121.9
CTRL ENTER	*roger Air Nomis flight 123*

ATC Environments Available:

There are 2 ATC environments available. The default one is EUROPE, it is loaded when you start AS2. The other one is North Atlantic, which presents you with a further 96 assignments between Europe and North America. You can switch between the 2 by either using the appropriate icon or by loading them via ATP Utilities.

Some remarks about ATC

The ATC of Airline Simulator 2 has some peculiarities that need mentioning to avoid possible problems.

ATC creates a bubble of 40 NM around the departure and destination airport. Within that bubble, only radar vectors are possible. Also, ATC is not aware of terrain, so it is up to you to maintain your terrain clearance. However, there are ways of staying safe while not annoying ATC.

On descent, you will not be derated for descending slower than normal, so if you have doubts about the terrain clearance, stay high. Once you are cleared for the approach, the controller will not derate you before you are fully established on the ILS. That means you can fly the full IFR procedure. If you have doubts about terrain, this is the way to do it.

Transition altitude is always 18'000 ft. This is due to the fact that ATC works after the US system.

On some airports you will note that the ATIS frequency is outside the range of the COM radios. This is because some ATIS broadcast via a local VOR. On airports where this happens, you can select frequency 127.00 Mhz to listen to the ATIS broadcast.

Rating system.

Any single or career flight is rated. There are 3 parts to the rating, Airmanship, Efficiency and Safety. In each category, the most common reasons for being derated are:

Airmanship:

Failed to check ATIS:	You have to check ATIS before requesting clearance and before contacting approach control.
Delays in retracting gear:	Gear must be up by 1000 ft AGL.
Airspeed low during dep:	Airspeed must be above 220 KIAS before reaching 3000 ft AGL.
Altitude and Heading deviation:	Any deviation of +-300 ft and / or 5° off commanded heading.
Exceeded Mach Limit	Exceeding the maximum speed for operation.
Loc/Glide deviation:	Excessive ILS deviations
Failed to set transponder	Transponder did not match assigned code.

Efficiency:

Each assignment has a calculated fuel burn. If you use considerably more fuel than calculated, you will be derated. You can check the pre programmed fuel levels using ATPUTIL.

Safety:

Failure to hold before take off	You took off without take off clearance.
Take Off in tail wind > 15 kt	Exceeded tailwind limit of 15 kt
Failed to climb below 1000 ft	A positive rate of climb must be maintained until 1000 ft AGL
Violated flaps schedule	Exceeded safe flap speeds.
Exceeded airspeed limit	Exceeded 250 kts below FL100 /10'000 ft.
Exceeded airspeed limit for gear	Exceeded Vlo
Failure to ident NAV radio	Any tuned nav radio must be positively identified by checking it's IDENT morse code.
Failure to report missed approach	
Landed in unforcast 0/0 conditions	Even tough your plane may be CAT III, you must have a minimum visibility to land.
Failed to perform commanded go around	
Unsafe fuel level:	Landed with less than 1/2 hour of fuel in tanks
Unsave plane orientation:	Indicates that the aircraft was pitched up more than 20° or pitched down more than 10 ° or had a bank angle of > 45°

Type ratings

After some flights, you will be offered type ratings. As these ratings are still part of the old ATC system, they do not correspond exactly with AS2, so here is the translation:

B737	-	First Officer MD 83
B767	-	Captain MD 83
B747	-	First Officer B747-400
ATP	-	Captain B747-400

You will be offered the flight test if your composite rating (average) is above

- B737 50%
- B767 60%
- B747 70%

The check flights will be

- B737 clear weather and calm winds
- B767 ceiling 500 ft, medium winds shifting at altitude
- B747 ceiling 500 ft, strong winds shifting on final approach.

The final check, the B747 captain check or ATP check requires:

- 50 career flights
- 12 approaches to a ceiling of less than 500 ft
- composite rating of 70% or greater

The ATP check flight involves a challenging flight with bad weather, low ceilings and shifting winds on the approach. If you succeed: CONGRATULATIONS!

ATC Controls: Keyboard summary:

"Roger" (Read Back)	Ctrl ENTER
Repeat Last Message	Ctrl Caps Lock
Request Clearance	Ctrl X
Contact New ATC Facility	Ctrl TAB
Request Taxi	Ctrl .
Request different Runway	Ctrl -
Request new altitude	Ctrl A
Report leaving altitude	Ctrl Q
Request frequency change	Ctrl F
Request radar vectors	Ctrl V
Report traffic / runway in sight	Ctrl T
Report missed approach	Ctrl M
Request taxi to ramp	Ctrl ,
Cancel assignment	Ctrl C

Assignment list EUROPE

Flight Assignments Europe

No	From	To	Type	Dist	Flight Time
1	VIE	ZRH	MD83	399	01:00
2	ZRH	ATH	MD88	911	02:17
3	ATH	VIE	MD83	721	01:52
4	VIE	DUB	MD88	992	02:28
5	DUB	LHR	MD83	284	00:53
6	LHR	CDG	B744	198	00:50
7	CDG	MAD	B744	596	01:32
8	MAD	SZG	B744	935	02:15
9	SZG	AMS	MD88	451	01:15
10	AMS	GEN	MD88	577	01:32
11	GEN	GVA	MD83	938	02:21
12	GVA	LIS	MD88	838	02:07
13	LIS	LGW	B744	892	02:10
14	LGW	ARN	B744	868	02:07
15	ARN	FCO	B744	1174	02:45
16	FCO	MUC	MD88	405	01:09
17	MUC	MAN	MD83	657	01:43
18	MAN	LIN	MD83	699	01:49
19	LIN	TXL	MD88	497	01:22
20	TXL	BCN	B744	858	02:05
21	BCN	BRU	B744	648	01:39
22	BRU	HEL	MD88	972	02:25
23	HEL	CGN	MD83	896	02:15
24	CGN	EDI	MD88	522	01:25
25	EDI	FRA	MD83	616	01:38
26	FRA	ATH	B744	1008	02:24
27	ATH	ARN	B744	1404	03:14
28	ARN	LIS	B744	1699	03:51
29	LIS	EDI	B744	1111	02:37
30	EDI	FCO	B744	1102	02:36
31	FCO	GEN	MD83	1200	02:56
32	GEN	AMS	MD83	560	01:30
33	AMS	BCN	MD83	698	01:48
34	BCN	TXL	MD83	879	02:13
35	TXL	BRU	MD88	381	01:06
36	BRU	LIN	MD88	429	01:12
37	LIN	MAN	MD88	690	01:47
38	MAN	MAD	MD88	836	02:07
39	MAD	GVA	MD88	574	01:32
40	GVA	HEL	B744	1184	02:46
41	HEL	DUB	B744	1237	02:53
42	DUB	ZRH	B744	727	01:49
43	ZRH	LHR	B744	463	01:17
44	LHR	MUC	B744	558	01:27
45	MUC	CDG	MD88	402	01:09
46	CDG	CPH	MD88	579	01:33

47	CPH	SZG	MD88	523	01:25
48	SZG	LGW	MD83	590	01:34
49	LGW	CGN	MD83	300	00:55
50	CGN	FRA	MD83	78	00:28
51	FRA	HEL	MD88	922	02:18
52	HEL	ATH	MD88	1432	03:27
53	ATH	ZRH	MD88	914	02:17
54	ZRH	LIS	MD88	966	02:24
55	LIS	FCO	MD83	1024	02:32
56	FCO	ARN	B744	1174	02:52
57	ARN	MUC	B744	786	01:56
58	MUC	AMS	B744	394	01:07
59	AMS	BCN	B744	698	01:45
60	BCN	VIE	B744	793	01:57
61	VIE	HEL	MD83	854	02:10
62	HEL	LIS	MD83	1933	04:34
63	LIS	LHR	MD88	895	02:15
64	LHR	GVA	MD88	448	01:15
65	GVA	LGW	MD88	417	01:11
66	LGW	FRA	MD88	365	01:04
67	FRA	MAN	MD88	495	01:21
68	MAN	MAD	B744	836	02:02
69	MAD	CPH	B744	1177	02:45
70	CPH	CGN	MD83	368	01:04
71	CGN	BCN	MD83	642	01:41
72	BCN	EDI	MD88	961	02:24
73	EDI	GVA	MD88	736	01:54
74	GVA	ATH	B744	952	02:17
75	ATH	BRU	B744	1189	02:47
76	BRU	GEN	B744	647	01:39
77	GEN	LIN	B744	951	02:17
78	LIN	CDG	MD83	366	01:04
79	CDG	TXL	MD83	515	01:24
80	TXL	DUB	MD88	769	01:58
81	DUB	FCO	MD88	1065	02:38
82	FCO	SZG	MD83	379	01:06
83	SZG	BRU	MD83	398	01:08
84	BRU	BCN	B744	619	01:35
85	BCN	CGN	B744	684	01:43
86	CGN	ARN	B744	694	01:45
87	ARN	ZRH	B744	863	02:06
88	ZRH	ATH	B744	911	02:00
89	ATH	CPH	B744	1217	02:50
90	CPH	MAD	MD88	1177	02:53
91	MAD	FRA	MD88	801	02:00
92	FRA	LHR	MD88	371	01:03
93	LHR	GEN	MD88	772	01:52
94	GEN	VIE	B744	814	02:02
95	VIE	SZG	B744	151	00:34
96	SZG	DUB	B744	868	02:07

Flight Manual B747 - 400

Part 1 Systems

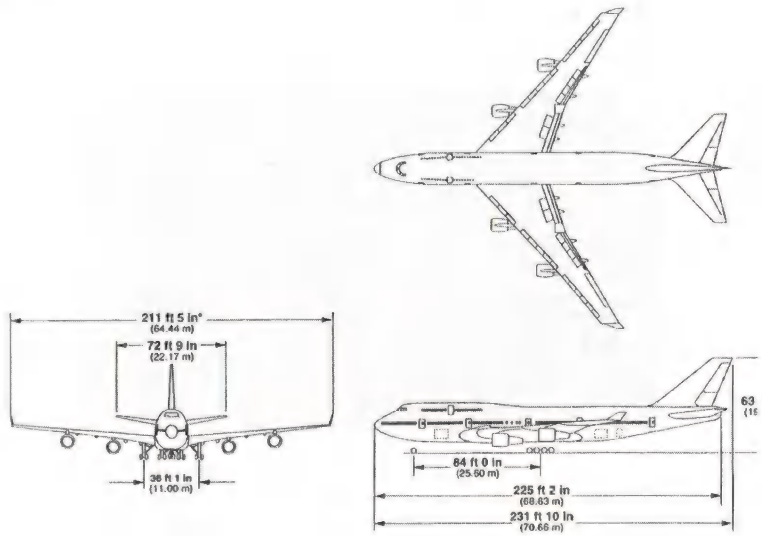
Airplane Description and General Information

The B747-400 series is a long range, heavy passenger and cargo transport plane, and it is one of the largest commecial aircraft in use.

It is powered by 4 wing-mounted RB211-524G Turbofan engines.

With the required equipment installed and operative, the aircraft is certificated for use in Category 3a conditions.

Dimensions



The cockpit layout of the B747-400 has been created to provide a concise overview. The cockpit is an EFIS system, the flight and system instruments are presented on cathode ray tubes (CRT's). In this simulation, 3 CRT's have been reproduced, the Primary Flight Display (PFD), the Navigation Display (ND) and the EICAS display.

The picture above shows the primary panel of the aircraft. The Primary Flight Display or PFD is located on the left, the Navigation Display or ND in the centre and the NOMIS 2900V Flight Management system to the right. Above the FMC, the EFIS control panel can be found which controls the features shown on the ND.

The centre panel is accessed with the TAB key. The controls for the Digital Flight Guidance System are located on top. Below to the left, the Engine and Control Display EICAS is shown. Next to the EICAS is the landing gear selector handle. The control position indicator is found to the right of the landing gear selector handle. Below it, the autobrake switch allows the setting of the autobrakes. On the right, the communication radios and the ATC transponder complete the panel.

Weight and Loading

1. Gross Weights

The aircraft must be operated within the specified weight and balance limits as shown below.
For permissible take off weight limits with regard to performance limitations check in the performance part of this manual.

Airplane	DOW	MZFW	MTOW	MLW	MRW
B747-400	401'000	563'000	870'000	630'000	872'000

2. Balance Limits

The aircraft must be flown within prescribed balance limits. In AS2, the centre of gravity is dealt with automatically, and provides in balance conditions throughout the flight.

The centre of gravity moves with added weight. This is set to represent the effect of loading passengers and freight as well as different levels of fuelling.

Flight Controls

The B747-400 is controlled via primary and secondary flight controls. The primary controls include Ailerons, Elevators and Rudders. The secondary controls include Flight and Ground Spoilers, Flaps, Leading Edge Slats and the Horizontal stabiliser. All flight controls are hydraulically operated.

Primary Flight Controls.

The primary flight controls are connected to the control column and rudder pedals. They work in a conventional way. The aileron system is connected to the control column wheels. The elevator system is connected to a hydraulic system that operates a the inboard and outboard elevators. The rudder is operated hydraulically and is connected to the rudder pedals.

Secondary flight controls.

Ground and Flight Spoilers

The ground and flight spoilers provider aerodynamic braking in the air and on the ground. In total there are 4 inboard spoilers which act as speed brakes, 5 outboard spoilers which augment the ailerons and 6 ground spoilers which open only on the ground.

The spoilers are operated from the cockpit by means of a control lever. To extend the spoilers, press the INSERT key on your keyboard, to retract them, press the DELETE key. The spoiler position is indicated in the multi function display shown below. Spoiler control has 4 positions: Down, Armed, Flight and Ground.

In the Down position, all spoilers are retracted.

In the Armed position, spoilers will extend automatically
- On Ground only, after wheel spin up on the main gear or with the nose gear on the ground.
- On rejected take off, with reversers actuated.

In the FLIGHT Position, spoilers will extend to the in flight speed brake position.
This will provide braking in the air.

In the GROUND position, ground and flight spoilers will extend, slowing the aircraft on ground.

In addition to the manual and armed spoiler extension modes, flight spoilers are also used to improve aileron effect in bank. If the control wheel is turned in excess of 5°, flight spoilers extend fractionally on the downward wing .

Flaps and Slats systems.

Flaps and slats are provided to improve low speed handling of the plane.

There are leading edge slats mounted on each wing. They are mechanically controlled by the flap/slat control lever in the cockpit, (keys + and - on the keypad) and are controlled electronically by the stall-warning and auto slat system.

The flaps extend from the rear of the wing. They extend to 1, 5, 10, 20, 25 and 30 degrees. The position of the flaps are indicated on the EICAS. Normally, a bar shows the position of the flaps and a pink line shows the selected position.

In case of defects, all flaps and slats are shown individually.

The flap limit speeds are: Flaps 1: 280 KIAS, Flaps 5: 260 KIAS, Flaps 10: 240 KIAS. Flap 20: 230 KIAS, Flaps 25: 205 KIAS, Flaps 30: 180 KIAS.

Warning System

The slats and flaps are protected from excessive aerodynamic loads by warning systems. An aural warning will sound if flaps are extended above 280 KIAS, and a flap relief system will retract the flaps from 30° to 25° with airspeeds above 178 KIAS, and to 20° on speeds above 203 KIAS.

Landing Gear

The landing gear consists of 4 main gear bogies with 4 wheels on each, and a steerable nosegear with 2 wheels. The undercarriage controlled via the [and] keys.

The nose and body gear steering is activated by pressing SHIFT /. When activated, the rudder position indicator is red. This enables full nosewheel deflection via the pedals or rudder control keys, which allows for tight turns.

An autobrake system controls braking after landing or during a rejected take off. The autobrakes switch is located on the secondary panel and is controlled via the CTRL M key combination. You may cycle through 4 different strengths of autobrakes. Additionally, the RTO position allows automatic braking in case of a rejected take off.

The landing gear position is indicated on the EICAS system. In normal operation, the EICAS displays the gear indication in green when the landing gear is down and locked. In transit, the gear indication changes into a rectangle with a line pattern. Once the gear is up and locked, the gear indicator blanks out.

Gear Down and Locked

Gear Up

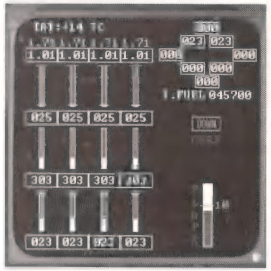
Gear in Transit (also as 1 square)

Power Plant

The aircraft is powered by four Rolls Royce RB211-524G engines. These engines are of an axial flow, high-bypass type with a large front fan. Each engine generates a static take off thrust of 58,000 lb.

Controls and Indicators

All the engine indications are presented on the EICAS display on the secondary panel. The parameters shown are:



TAT: Temperature TO (green) Engine Power Mode

Thrust Limit (green) for engines 1-4. In the boxes below are the actual EPR readings.

The first graphic display shows the EPR for each engine, together with a red line indicating its maximum limit and a green line indicating the current limit, which is also displayed above. A white line shows the commanded setting, corresponding to the throttle position.

The N1 indicators are under the EPR graphic. Below them are the EGT indications, and the bottom display is the fuel flow in 1000 lb.

On the right side, the EICAS shows the fuel quantity, and gear and flaps indicators.

Engine Operating Limitations

EGT
- Start: 535 deg C
- Take Off / GA 650 deg C up to 5 Minutes
- Max Continuous 625 deg C

N1 111.4%
N2 105.5%

Starting and shutting down of engines.

The AS2 engines feature full FADEC controlled automatic start and shut down sequences. This has been introduced in reduce the work load for the pilot who has to perform the task of 2 pilots here. To start an engine press the E key followed by the engine number. Only one engine may be started at a time. To shut down an engine press O followed by the engine number.

Thrust Setting via FMC

	11:36:50/01x	
PRF		
CLB	A.MOD:	T/O
CRU	EPR L:	1.71
MCT	O. FL:	373
T/O	O.SPD:	.850
RET	D.STC:	250
	T.STC: 00:00	

The manual setting of thrust limits is executed via the FMC V-NAV page. Set the active mode by pressing LSK 2-5 for Climb (CLB), Cruise (CRU), Maximum Continuous Power (MCT) and Take Off / Go Around (T/O).

	11:36:50/01x	
SLT		
ACH	TAT	: +14
SPD	SEL	: +14
CFL	ACC.H	:1500
CI	SPD	: 157
RET	CR.FL	: 290
	COST	: 76

The VNAV Performance Page allows the setting of Reduced Take Off thrust via assumed temperature. SLT selects an assumed temperature for take off. It can only be higher than the actual temperature. Engine performance will be derated according to the entered temperature.

For more information on the VNAV part of the NOMIS 2900v FMC, please consult the FMS chapter above.

Thrust Reverse System

A thrust reverse system is mounted on each engine to provide increased deceleration on landing or take off abort. Thrust reverse buckets are installed at each engine exhaust. Upon activation by the pilots, the buckets deploy and redirect engine thrust into the slipstream, causing rapid braking.

Controls and Indications

Thrust reverse can be selected on ground by

- Retarding the throttles into idle position
- Pressing 9 on the main keyboard
- Applying thrust with the throttles.

After pressing the 9 key, verify that the reversers have activated, by checking the EPR limit prompts have changed to a yellow REV indication on the EICAS. Also, on the main instrument panel, the thrust levers move into the red range as more power is applied.

Reverse will be cancelled by pressing 0 on the main keyboard with the throttles in idle position.
NB PC hardware limitations mean that the computer throttles can not be made to operate in the way that real world reverse thrust is applied, so to get more power when stopping the aircraft, the throttles have to be opened in the same direction as is used in normal flight.

Limitations

Thrust reverse should not be used below 60 knots indicated. If necessary, apply very careful idle power reverse only. Compressor stalls may easily occur below 60 knots with reversers deployed.

Fuel System

The fuel system consists of main, centre and auxiliary tanks, which altogether can carry 342000 lb of fuel.

There are 4 main tanks located in the wings, a centre tank in the body, 2 reserve tanks in the wings and a balance tank in the stabiliser.

Fuel is provided to the engines by means of boost pumps and by transfer valves which assure optimum feed to all engines.

A fuel jettison valve permits reducing the fuel load in flight. In AS2, fuel load can be reduced via the F6 / loading menu at any time in flight.

The fuel system of the simulated aircraft is fully automatic.

The fuel quantity indication is located in the EICAS. All tanks are shown individually, and a grand total of fuel on board is shown at the bottom of the fuel display.

Communication Systems

The B747-400 is equipped with 2 760 channel communication receivers, featuring dual frequency displays. This allows the entry of a frequency before activating it, which is done by CTRL 0 (zero on the letterpad) or by clicking on the transfer switch between the two windows.

On this picture you can see the COM frequency selectors. They can be mouse operated or operated by the keyboard sequences

Select COM1	Ctrl	1
Select COM 2	Ctrl	2
Select Transponder	Ctrl	3
Full MHZ up or down	Ctrl	= / -
Fractional MHZ up or down	Ctrl	[/]
Transfer from Stand by to Active	Ctrl	0

To communicate with ATC, you have to select which COM radio you want to use. Use the Ctrl 1 and Ctrl 2 controls for this. The selected COM will display in yellow. You can now change frequencies using the keyboard or use the radio to talk to ATC. If you want to only listen (e.g. to an ATIS) this can be done without activating the COM but by simply setting the frequency.

The ATC Transponder below has no other working parts then the code setting. Set the proper code by using the mouse or keyboard as described above.

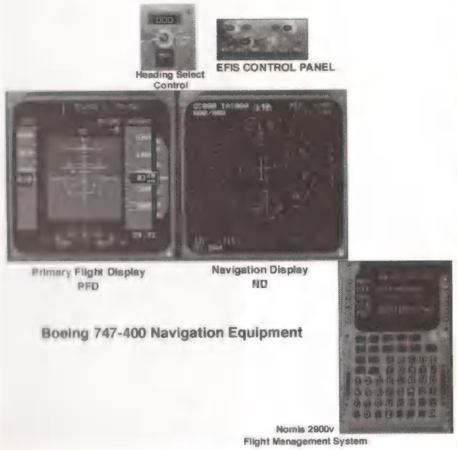
Navigation Systems

The Navigation system of the B747-400 consists of 2 VHF navigation receivers featuring ILS and VOR reception, 2 DME receivers, 1 ADF receiver and a GPS/IRS based NOMIS 2900v Flight Management System. The systems provide full navigation capabilities for all modes of navigation including RNAV as well as ILS approach capabilities down to ILS CAT 3 minima.

Display of all the Navigation information is provided by the Electronic Flight Instrumentation System or EFIS. Navigational information is shown on the so called „NAVIGATION DISPLAY„ or ND, the second visible screen in front of the pilot. There are several different presentation modes for the ND, which are controlled by the control panel mounted on top of the FMS on the primary Cockpit.

Frequency selection is provided via the FMS radio page. It can be accessed from the main index page with LSK 1, NAV. For further information on how to set frequencies via the FMS please refer to the FMS chapter earlier.

The picture on the left gives a basic overview of the navigation equipment.



Boeing 747-400 Navigation Equipment

The **Primary Flight Display (PFD)** gives the main flight data. Aircraft attitude, speed, speed trends and limits, altitude, heading, rate of climb and descent and heading data. The ILS indications from NAV 1 are also on this instrument, and there are a number of annunciators controlled by the DFGS.

The **Navigation Display (ND)** provides an image of the horizontal situation within the navigation. It incorporates a standard HSI mode, and also gives information about the distance and bearing to navaids and waypoints, as well as winds aloft and groundspeed readout. The indications on the ND are largely controlled via the NOMIS 2900v FMC. It is the primary input source for navaids and route information. The different modes of the ND are controlled via the **EFIS CONTROL PANEL (ECP)** pictured above it. It controls the display modes of Rose, Arc, Map and so on, and is also used to switch on and off the other options such as weather radar, waypoint overlay and range arcs. A last control for the ND can be found on the control panel of the Automatic Flight Control System. It allows the preselection of the heading bug featured in both the ND and the PFD.

Navigation Display

Let's now look at the Navigation Display in more detail. The ND has 2 presentation modes, the Rose Mode, which is derived from the conventional analogue style HSI, and the ARC mode, which shows only a part of the area in front of the aircraft. The Rose and Arc modes both have several identical facilities, allowing display of an ILS Approach track, VOR track and moving map. A further mode is unique to Arc mode, is plan mode.

On the ND control panel, the upper left button controls the Minimum Radio Altitude setting, triggering the Minimum Alarm. The upper right button controls the barometric pressure setting for the altimeters.

On the second row, the left button controls the mode of the ND. Rotating it from left to right toggles APP, VOR, MAP and PLN mode, pressing it in the middle will toggle Arc and Rose mode. This button is controlled via the key combinations SHIFT K to press the button and SHIFT J and SHIFT L to turn it left and right. The right hand knob controls the display range of the ND. It is activated via SHIFT E and SHIFT R to turn it left and right. The display ranges available are 10, 20, 40, 80, 160, 320 and 640 NM.

On the bottom row, there are 6 pushbuttons, which control the detail display on the ND.

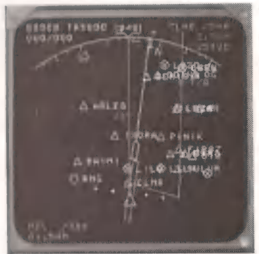
From left to right
WTX toggles weather radar display on and off.
STA toggles display of VOR and NDB stations.
WPT toggles display of navigation fixes and waypoints.
ARPT displays all available airports within the selected range.
DATA is not currently in use
POS if not currently in use
These last two functions are covered in the ND by other means.

In the following pictures, you can see all the different representations of the Navigation display.

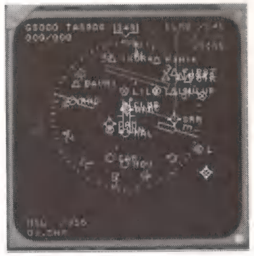
In all the displays, on the top left, the ground speed, true air speed and wind is shown.

On the top right, either the active waypoint with its bearing, distance and ETA is shown, or, with no FMC route active, the same information is shown for the navigational aid tuned into NAV1. If a route is active, this information is displaced to the bottom left. On the bottom right, information for NAV 2 is shown. You can always follow the information trail on the color. What is shown on top right is pink, so if NAV 1 is shown there, a pink arrow will represent Nav 1 in the ND. What is shown on the bottom left is green, on the bottom right blue.

In all ND modes, facilities like airports (crossed circle), Navaids (VOR symbol, a circle with 4 dots attached), NDBs, (circle) and Waypoints (triangles) can be superimposed by activating the ARPT, STA, WPT buttons on the ECP.



The map mode is the most common used one. It displays the programmed FMC route in pink. In this mode, no real CDI is shown, only on the bottom, a diamond shape CDI is available for NAV2. Nav 1 is indicated as a green arrow. The pink heading bug draws a dotted line when moved, to make targeting a waypoint easier.
The VOR mode shows NAV2 with an enlarged CDI. The lubber line with the CDI attached is placed according to the preset radial.
The Approach mode will superimpose a CDI for a Localizer selected on NAV 2 and its glide slope indication on the right. The rest of the display remains unchanged.



In Plan mode, the ND shows a North Up view of the flight plan entered in the FMC. It is important to understand the significance of the North Up, as the picture will no longer correspond to the setting of the compass rose on top. The Plan mode should not be used in the air, but mainly as a ground tool to verify the graphic outlook of a flight plan.

Primary Flight Display

The primary flight display contains all the main flight information such as attitude, heading, altitude and airspeed, plus a number of other parameters and indications.

On top, three separate columns indicate the modes of the automatic flight control system, AFCS. The left column gives thrust data, the centre one lateral (LNAV) modes and the right one vertical (VNAV) modes.
On the left, the airspeed indicator provides a digital and graphical readout of Indicated Airspeed (IAS) in knots. On top of it, a pink digital readout shows the currently selected speed set in the AFCS panel. The same speed is also marked with a pink marker which runs along the speed tape. Below the speed tape, the MACH number is displayed when speeds are above a minimal value. Within the speed tape, the critical V speeds are marked in green, once they have been set in the FMC. However, these V speeds need to be used with caution, as they are not corrected for runway length or obstacles. For accurate V speed information, refer to the performance section of this manual.

On the far right, a Vertical speed indicator shows the rate of climb or descent. Next to it, the altimeter tape shows the barometric altitude of the aircraft in ft. The set pressure is shown underneath the altimeter band. A pink marker defines the preselected altitude set on the AFCS panel, and the set altitude is also shown above the Altitude tape. Please note that a preset altitude must be armed by using SHIFT F10 before it will display on this spot.

On the bottom of the instrument, the top of a compass rose provides heading indication. A heading bug gives guidance on the preselected heading. The actual heading is also displayed to the left of the centre point.

In the centre of the PFD, the attitude and flight director indicator allows precise guidance of the aircraft along the pitch and roll axis. Flight director bars may be switched on via the AFCS control panel to provide guidance in pitch and roll. If an ILS is being tracked by NAV 1, a localizer and glideslope indicator appears on the bottom and right side of the horizon sphere, providing localizer and glide slope information. The ILS Ident and DME are then displayed on the top left of the horizon sphere.

The horizon sphere itself consists of the white aircraft symbol, a blue and brown horizon sphere with white pitch marks. On top, the bank angle is indicated by white marks against a white triangle. The lower part of that triangle moves to give a skip / slip indicator. This indicator is a vital tool in identifying a uncoordinated flight situation, such as an engine failure.

On the top right of the horizon sphere, the radio altimeter provides the height above ground of the main landing gear. On the ground, the sensor of the radio altimeter is about 8 ft below its nominal setting for landing attitude, hence the indication of -8 ft. Above the actual indication, the preset Decision Height (DH) is displayed. It can be modified using the DH button on the Glareshield panel.

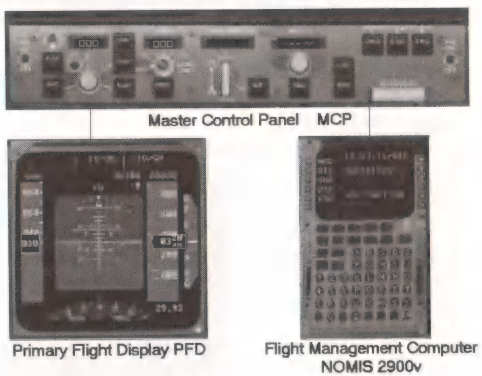
In the centre above the horizon sphere, the status indication of the AFCS is displayed. If active it shows CMD for Command, FD for Flight Director only, LAND3 or LAND2 during autoland and so on.

Automatic Flight Control Systems

The B747-400 is equipped with a Automatic Flight Control System. The system consists of the following components:

- **Autopilot** — **AP**
- **Flight Director** — **FD**
- **Master Control Panel** — **MCP**
- **EFIS Annunciators**
- **Autothrottle** — **AT**
- **Flight Management Computer** — **FMC**
- **Yaw Damper** — **YD**

Boeing 747-400 Autopilot System



The following picture gives an overview of the complete Autopilot system.
The main user interface is the Master control panel, or MCP. All actions such as engaging and disengaging the autopilot, setting modes and entering values done through the MCP. The Mode annunciators are displayed on the PFD above the horizon sphere.

The NOMIS 2900 v FMC provides input signals for the auto flight system's LNAV and VNAV modes.

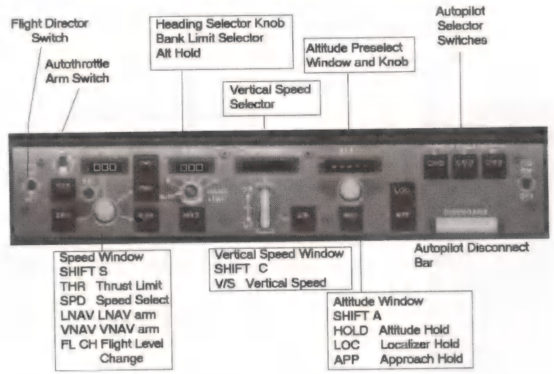
General Overview

The autopilot / flight director system may be used in all stages of the flight. The following functions are available for the autopilot and / or flight director.

- Take Off
- Vertical Speed / Altitude Hold.
- IAS / Mach Hold
- Turbulence Mode
- Heading Hold / Heading Select
- VOR Capture and Tracking
- LNAV Capture and Tracking (in conjunction with NOMIS 2900V FMC)
- VNAV Capture and Tracking (in conjunction with NOMIS 2900V FMC)
- Flight Level Change
- ILS Capture and Tracking
- Go Around
- Auto Land

Controls and Indicators

The Autoflight System is controlled via the Master Control Panel (MCP)



The knobs have special functions again. To arm an Altitude press SHIFT F10.

It is very important to understand the philosophy of the keyboard layout.

Flip Autopilot Master	SHIFT Z
Flip Autothrottle Master	SHIFT V
Flip F/D Switch	SHIFT W
Select TOGA	SHIFT D
Select speed Window	SHIFT S
Select heading Window	SHIFT X
Select vertical speed window	SHIFT C
Select altitude window	SHIFT A

Depending on active window various functions SHIFT-F1 to SHIFT-F10

Speed Window active:	
THR	SHIFT F2
SPD	SHIFT F3
LNAV	SHIFT F4
VNAV	SHIFT F5
FLCH	SHIFT F6
Select IAS/MACH	SHIFT F9

Heading Window active:	
decrease bank angle limit	SHIFT F7
increase bank angle limit	SHIFT F8
Heading Hold	SHIFT F9
Heading Select (Push button)	SHIFT F10

Vertical Speed window active:

Activate vertical speed	SHIFT F6

Altitude Window active:

LOC	SHIFT F5
APP	SHIFT F6
Hold altitude	SHIFT F9

Flight Mode Indication is given on the Primary Flight Display.
The top of the PFD has 3 sections for mode annunciation of the automatic flight control system. The left, blank here, shows the Auto Throttle Modes, the centre one the Roll modes and the right one the Pitch modes.

In the centre above the horizon sphere, the main AFCS indications are shown, to give the pilot a quick and clearview of the status of the AFCS system.

Possible Flight Mode Indications

AFCS Main Display Annunciators:

FD	Flight Director ON, Autopilot OFF
CMD	Autopilot is engaged
LAND3	Autoland with 3 Autopilots engaged
LAND2	Autoland with 2 Autopilots engaged
NO AUTOLAND	Autoland not possible

Auto Throttle modes	**(Left Column)**
THR	Maintains commanded thrust as preselected in the VNAV page of the FMC Used with FLCH climb, and TOGA.
THR REF	Maintains the current EICAS display limit thrust
ILDE	Retards throttle to idle
HOLD	Allows manual setting of the throttles
SPD	Holds commanded speed / Mach

Roll modes	**(Centre Column)**
HDG SEL	Holds heading set on the MCP
HDG HOLD	Holds present heading
ATT	Holds bank angle if larger than 5 degrees
LNAV	Holds FMC preprogrammed track
LOC	Holds Localizer set in NAV 1
ROLLOUT	Appears armed at 1500 ft in an autoland approach engages at 5 ft
TOGA	Take Off / Go Around Mode, maintains runway track. arms in flight upon glide slope capture or flaps setting arms on ground if FD is switched on first.

Pitch modes	**(Right Column)**
FLCH SPD	Holds MCP Speed /Mach selection
VNAV SPD	Holds FMC speed or MCP speed if different speed set.
VNAV PATH	Holds cruise or descend profile
VNAV ALT	Holds an altitude constraint entered in the MCP
ALT	Holds MCP altitude
V/S	Holds MCP vertical speed
GS	Holds Glide Slope
FLARE	Flare manoeuvre during autoland. arms at 1500 ft during autoland approach engages at 50 ft
TOGA	Holds 15 deg pitch or pitch limit in transition to airspeed - in take off MCP speed plus 10 kts in go around MCP speed plus 25 kts arms in flight upon glide slope capture or flaps setting arms on ground if FD is switched on first.

Autothrottle System

The autothrottle system is independent of the AP system. You can fly with AT engaged but AP disengaged, but it is not recommended. The AT is armed with the AT switch on the MCP. It will engage upon activation of any of the AT modes. It will control the throttles in all the modes mentioned on the left, but will revert to manual throttle control in HOLD mode.

Modes and Operation

Basic Mode

The Autothrottle has no basic mode per se, it can be engaged on either THR or SPD mode. For SPD mode set the required speed or Mach number in the Sped window. Then set the AT switch to ARM. Press the THR or the TOGA button to engage the mode. The PFD will show the relevant indication.

PFD: _SPD _ _ _
_ _ _ _

To change the preselected speed, press SHIFT S and SHIFT + and - keys.

If you engage the AT via thrust mode, either press SHIFT S followed by SHIFT F3 or the TOGA button SHIFT D.

Thrust modes

The thrust modes shown in the table can be engaged by pressing the THR button on the MCP or the TOGA button. The different thrust ratings can then be set via the FMC. Pressing the SPD or MACH button will cancel thrust mode.

PFD: _THRREF _ _ _
_ _ _ _

_THR _ _ _
_ _ _ _

THR mode will initially set take off thrust once engaged but will then revert to HOLD mode. HOLD mode means the Throttles are under manual control with AT engaged. This means, that in Take Off, the joystick throttle must be moved to take off position manually during acquisition before HOLD mode is reached, otherwise the throttles may retard !

THR mode is active with either FLCH or TOGA mode in pitch. In other pitch modes, THR REF will display, indicating that the autothrottle will hold the EPR limit as commanded by the FMC and displayed on the EICAS.

AFCS Operational Checklists.

AP / FD basic mode

When the AP or FD is first engaged, it will enter by default in TOGA and TOGA mode in pitch and roll.

1. FD Switch	FD	PFD	_	_TOGA	_TOGA	_
			_	_	_	_

If the vertical speed was not 0 at the time of engagement, the AFCS will engage HDG and ALT hold. .

1. FD Switch	FD	PFD	_	_HDG HOLD	_ALT	_
			_	_	_	_

The FD command bar will command a level off and hold the heading.

2. AP ON if desired

TOGA mode

FD: Initial conditions: On ground, FD-ON, AP - OFF, lined up and cleared for Take Off.

1. Push TOGA button	PFD	_THR	_ TOGA	_TOGA	_
		_	_	_	_

The PFD shows AT in THR mode, both pitch channel and roll channel in TOGA.

2. While the engines are spooling up, move the joystick throttle control lever to the take off power detent. Otherwise, the AT will revert to HOLD and the joystick throttle will retard the power again.
3. After a normal rotation and lift off, the FD Pitch bar is centred upon reaching V2+10 kts
4. To engage HDG Select, set the bug on the heading you wish to follow and pull it. (Click mouse on it with SHIFT key pressed or set the heading window active and press SHIFT F10.)
5. PFD will show HDG SEL engaged.

_THR	_ HDG SEL	_TOGA	_
_	_	_	_

VERT SPD Mode

1. Vertical Speed mode engages when if the FD is engaged and / or the AP is on.
2. Press the V/ S mode button. (This deselects any other pitch mode).
   The PFD will show

_	_	_VERT SPD	_
_	_	_	_

To change the vertical speed, use the thumbwheel below the readout.

The VERT SPD mode disengages if
- another pitch mode is selected
- a glide slope is captured
- a preselected Altitude is captured.

VNAV Mode

1. Vertical Navigation engages when if the FD is engaged and / or the AP is on.
2. Press the VNAV mode button. (This deselects any other pitch mode).
   The PFD will show

	_THR REF	_	_VNAV SPD	_
	_	_	_	_
or	_SPD	_	_VNAV ALT	_
	_	_	_	_
or	_SPD	_	_VNAV PATH	_
	_	_	_	_

3. If VNAV mode is selected before take off, it will arm, that is be displayed below the TOGA mode sign in the pitch channel until positive climb has been set.

ALT HLD Mode

The altitude hold mode engages if:

- AP/FD is initially engaged with no vertical speed present.
- An armed altitude is captured PFD:

_SPD	_	_ALT	_
_	_	_	_

- the ALT HLD mode selector switch is pressed.

The ALT HLD mode disengages if
- another pitch mode is selected
- a glide slope is captured.

LNAV Mode

1. LNAV mode will engage when the FD is engaged and / or the AP is on.
2. Press the LNAV mode button. This arms LNAV.

LNAV: Preprogram a route in the FMC. Verify the next waypoint in the PRO page and make sure that you are steering towards the correct waypoint. Select HDG SEL or HDG HLD on the AP/FD on a suitable intercept heading. Press the LNAV button.

PFD	_	_HDG SEL	_	_
LNAV is now armed	_	_LNAV	_	_

When the selected track has been acquired, track mode will activate.

PFD	_	_LNAV	_	_
	_	_	_	_

FLCH Flight Level Change mode

Flight Level Change mode can be selected by pushing the FLCH mode selector on the MCP. It adjusts the pitch so that the selected IAS or MACH is held. With AT engaged, use thrust mode only.

PFD:	_THR	_	_FLCH	_
	_	_	_	_

The FLCH mode disengages if
- another pitch mode is selected
- a glide slope is captured
- a preselected Altitude is captured.

HDG HLD mode

The HDG HLD mode is engaged
- Upon initial engagement of the FD/AP
- Manually if the AP is engaged in any other cruise roll mode by pushing the HDG selector knob to the second detent. (SHIFT X followed by SHIFT F9 or mouse click with held CTRL key).

PFD:	_	_HDG HOLD	_	_
	_	_	_	_

If engaged in a turn the HDG HLD mode will first roll the wings level and then hold the resulting heading. The maximum bank angle is limited by the bank angle selector.

HDG hold mode will disengage when a LOC capture occurs, the HDG Selector is pulled into HDG select mode or LNAV is captured..

HDG SEL mode

HDG SEL mode will acquire and hold the heading selected in the HDG window which is also displayed on the heading bug. It is activated by pulling the HDG select knob (SHIFT mouse click or SHIFT X followed by SHIFT F10)

PFD:				
	_	_HDG SEL	_	_
	_	_	_	_

A new heading can be selected with the knob at any time followed again by a pull of the knob to acquire it.

HDG SEL mode will disengage when a LOC capture occurs, the HDG Selector is pushed into HDG HLD mode or LNAV is captured.

LOC Mode

1. LOC mode will engage when the FD is engaged and / or the AP is on.
2. Press the LOC mode button. This arms LOC. A valid localizer signal must be received on NAV 1.
3. Select HDG SEL or HDG HLD on the AP/FD on a suitable intercept heading.

PFD				
	_	_HDG SEL	_	_
LNAV is now armed	_	_LOC	_	_

When the selected LOC has been acquired, track mode will activate.

PFD	_	_LOC	_	_
	_	_	_	_

APP Mode

APP mode captures and follows the ILS tuned on NAV1. LAND 3 mode will initiate the auto land sequence at 1500 ft RA, The following sequence will work with LAND3 mode

Initially, set the ILS you need on NAV1 with the correct inbound track of the ILS. Engage the FD. Select a suitable intercept heading and altitude with the HDG SEL and ALT HLD functions. Select a suitable approach speed on the AT. Then press the APP button.

PFD	_SPD	_HDG SEL	_ALT	_
	_	_LOC	_GS	_

When the aircraft is established on the localizer inbound track the FMA changes to

PFD	_SPD	_LOC	_ALT	_
	_	_	_GS	_

Once the glideslope is captured, GS TRK mode will become active.

PFD	_SPD	_LOC	_GS	_
	_	_	_	_

At 1500 ft, the Rollout and Flare modes will arm

PFD	_SPD	_LOC	_GS	_
	_	_ROLLOUT	_FLARE	_

Automatic Landing

At 1500 ft RA, the autoland sequence begins and starts to evaluate if Autoland is possible. If the system decides that for any reason that autoland is not possible, the „NO AUTOLAND„ annunciator will turn on in the PFD. In this case, the AP disconnects at 300 ft RA.

If everything goes to plan, Autoland mode will now engage at 1500 ft. LAND 2 or LAND 3 will be announced in the centre annunciator of the PFD.

At approximately 50 ft RA, the Flare manoeuvre starts, accompanied by retard mode of the Autothrottle (IDLE, see AT section)

PFD	_IDLE	_LOC	_FLARE	_
	_	_ROLLOUT	_	_

At 5 ft RA Roll out mode engages and keeps the aircraft on the runway centreline with nosewheel steering and rudder.

PFD	_IDLE	_ROLLOUT	_FLARE	_
	_	_	_	_

After touchdown and full power retard:

PFD	_	_ROLLOUT	_	_
	_	_	_	_

Once the AP is no longer needed, disengage it.

LIMITATIONS: Autoland may only be performed on CAT II and III approved runways. Do not try to autoland on a runway that has an offset localiser

Indicators and Warning Systems

Master Warning Light

The master warning light in the glareshield will illuminate on one of the following conditions:

- **Fire in Engine / APU / Wheel Well / Cargo Bay.**
- **GPWS in take off and landing configuration**
- **Auto Pilot Disconnect**
- **Overspeed**
- **Cabin Altitude.**

Master Caution Light

The master caution light in the glare shield will illuminate on one of the following conditions

- **Engine Overheat**
- **EICAS Caution messages**

Ground Proximity Warning System

The B747-400 is equipped with a Ground Proximity Warning System that will protect the aircraft from inadvertent terrain closure. The GPWS operates from signals provided by the Radio Altimeter and barometric rate inputs.

The GPWS operates throughout the flight but is limited during take off and approach. In take off, the system activates 5 seconds after the gear is up or above 100 ft, whichever is later. During the approach, the system is active from below RA 2450 ft and above 50 ft.

The different modes of the GPWS are as follows:

MODE 1 Excessive sink rate „SINKRATE- PULL UP„

Mode 1 activates when the sink rate is excessive in relation to the radio height. The warning will trigger on a linear basis with descent rates above 5000 fpm at 2450 ft and 1200 fpm at 50 ft.

MODE 2 Excessive terrain closure „TERRAIN - PULL UP„

Mode 2 activates upon excessive terrain closure rate.

MODE 3 Altitude loss on take off or go around: „DON'T SINK„

MODE 4	Unsafe terrain clearance with gear up:	TOO LOW, TERRAIN	speed/altitude triggered
		TOO LOW, GEAR	gear not down and 1000 ft AGL or below
	with flaps not in landing configuration	TOO LOW, TERRAIN	speed/altitude triggered
		TOO LOW, FLAPS	flaps not in landing configuration.

MODE 5 Glideslope deviation on ILS GLIDE SLOPE

MODE 6 Altitude Advisories on landing approach. Calls out radio altitudes on landing approach.

MODE 7 Windshear warning. „WINDSHEAR„.

Part 2 Standard Operation Procedures

The standard operating procedures are provided to give you guidelines on how to operate the aircraft in all stages of flight. Adherence to them will give you the optimal flight parameters and best results operating the B747-400

However, these checklists have been provided by human beings and can not replace common sense and good flying practice. Also, circumstances may arise where the use of these checklists may delay needed action. In these cases, feel free to use your own judgement.

The Standard Operating Procedures are split into several sections. Please refer to them for all questions you might have on the operation of the flight.

Flight Checklists:	**Standard flight crew checklists covering normal procedures, which will give in depth explanations of each item.**
Abnormal Checklists:	**Abnormal operating procedures and checklists.**
Emergency Checklists:	**Emergency checklists and procedures.**

All the following checklists have been abbreviated from the real B747-400 checklists. Also items which can not be performed in the sim but are necessary for understanding of connecting items, are printed in ITALIC font.

Flight Checklists

The flight checklists cover a normal flight from beginning to the end with all checkpoints needed to perform it.

FLIGHT CHECKLISTS

Cockpit Preparation

1. Pins, Pitot covers	ON BOARD
2. Oxygen Masks, Mikes and Regulators	CHECKED
3. Parking Brake	ON
4. Landing Gear Lever	DOWN
5. Flap Position Indicator and Flap Lever	AGREE
Check flaps indication and position of flap lever.	
6. Flight Director Switch	ON
7. EFIS Control Panel	SET
8. FMS-CDU	SET
Route	ENTER
Performance Page	CHECK
Radio Page	SET
9. Weather Radar Panel	SET
10. Radio Tuning Panel	SET
Set COM frequencies as required	

11. Transponder Panel	SET
Set Transponder Code as required	
12. Autobrake Selector	SET
Set Autobrake selector to RTO	
13. Clock	SET
14. PFD	CHECKED
Check Flight Mode Annunciation:	
Verify Autothrottle mode blank	
Verify roll mode TO/GA	
Verify pitch mode TO/GA	
Displays	NORMAL
Verify no flags displayed	
No V-Speed flag until V-Speeds selected	
15. ND	CHECKED
Check Heading / Track is correctly displayed	
Check route display correct.	
16. GPWS Panel	SET
Ground Proximity Light	EXTINGUISHED
GPWS Flaps Override Switch	OFF
GPWS Gear Override Switch	OFF
17. Speedbrake Lever	DOWN
18. AFDS MCP	SET
Autothrottle Switch	ARM
Bank Limit Selector	AUTO
Disengage Bar	UP
19. ATC Clearance	OBTAIN
20. Fuel Quantities	CHECK
21. FMC route	AMEND
Enter SID waypoints as required	
22. Trim	SET
23. Loadsheet / LMC	CHECKED
24. Stabiliser	SET
25. Flaps	SET TAKE OFF
26. FMC Performance Page	ENTER PAYLOAD
Set payload in FMC performance page	
Check V-Speeds and verify.	
27. Speed Bugs	CHECKED
28. Start Up / Pushback	APPROVED
---- For Pushback	-----
29. Parking Brake	RELEASE
30. Pushback	INITIATE

ENGINE START PROCEDURE

1. Normal Start Sequence	4,3,2,1
2. Clear Signal	RECEIVED
3. Call Start _	PRESS E_ (Engine Nr)
4. N3, Fuel Flow, EGT	MONITOR
5. Repeat for other engines	

AFTER ENGINE START

1. Slides arm	REQUESTED
2. Seat Belts	ON
3. All Clear Signal	RECEIVED
4. Taxi Clearance	RECEIVED
5. Taxi Light	ON
6. Flight Controls	CHECKED
Check full travel of all axis: Elevator, Rudder and Aileron.	
4. Flaps / Slats	TAKE OFF
5. Off Blocks Time	NOTED

TAXI CHECK

1. Brakes	CHECKED
Check brakes effectivity immediately after roll starts.	
2. Flight Instruments	CHECKED
Check ASI	0
Check PFD	Horizon Stable
Check VSI	0
Check ND Heading in turns	
3. ATC Clearance	VERIFIED
- Verify ATC clearance and check navigation aids .	
- Set DFGS accordingly	
- Arm restricting Altitude	
- Check PFD Mode Annunciators	
- Set Transponder to assigned code.	
4. Take Off Briefing	COMPLETED
5. Flaps / Slats / V-Speeds	RECHECKED
Check Take Off Weight / Flap Setting	
Verify V-Speeds and Corrections	
6. Flight Attendants	INFORMED
7. Cabin	SECURED
8. Windows	CLOSED
9. EICAS	NO WARNINGS
10. Spoilers	DOWN / DISARMED
11. Autobrakes	RTO

CLIMB

1. Altimeters	SET / COMPARED
When passing transition altitude set QNE and compare indications	
2. Spoilers	DISARMED / RETRACTED
3. Flaps / Slats	UP / CHECKED
4. Climb Power	SET
5. Landing / Taxilights	RETRACTED / OFF
6. Seat Belts	AS REQUIRED

CLIMB CHECK COMPLETED

DESCENT

1. Landing Data — CHECKED
   - Calculate Landing Weight
   - Check expected landing weight to correspond to Gross Weight reading on the Fuel QTY panel minus the descent fuel.
   - Select FMS performance page to set speed bugs
2. Approach Briefing — COMPLETED
   - Brief Approach as laid out in the according chapter of the flight school.
3. Navigation — SET
   - Set and check frequency and course on NAV1.
   - Set 250 kt or limiting speed on SPD/MACH readout and check bug movement
   - Set bank angle limit as required.
   - Set initial altitude in the ALT window, pull ARM and check readout on the announciator.
   - Set and check frequency and course on NAV2.
   - Set and check frequency of the ADF.

APPROACH

1. Seat Belts — ON
2. Altimeters — SET AND COMPARED
   - Set altimeter to QNH and check readout.
3. Radio Altimeter — SET MDA/H
   - Set applicable minimum MDA/H for the selected approach.
4. LNAV Mode — DISENGAGED
   - Disengage LNAV mode if engaged. Use HDG SEL or other roll mode for interception.

FINAL CHECK

1. GEAR	**DOWN**
2. FLAPS / SLATS	**SET**
3. SPOILERS	**ARMED**

AFTER LANDING

1. Flaps	UP
2. Spoilers	RETRACTED
3. Landing Time	NOTED

PARKING CHECK

1. Flaps / Slats	UP
2. Parking Brakes	SET
3. Engines	STOP
4. Seatbelts / Slides	OFF / DISARMED

PART 3 NORMAL PROCEDURES

Taxi

Taxi with caution and care. This is a large aircraft and you need to watch out for obstacles in your way.

Take Off

When cleared for take off, verify you are correctly lined up on the runway, then release the brakes. Advance the thrust levers to about 1.1 EPR. Monitor engines spooling up. Push the TOGA switch. Verify that the correct take off thrust is set. Check 80 knots call. Rotate at Vr and establish a positive rate of climb at V2+10 kts. Verify the climb rate is positive and then select gear up. Check gear retraction. Verify that LNAV/VNAV have captured. Above minimum altitude for autopilot engagement, engage autopilot. Above flap retraction altitude, accelerate to flaps up speed and retract flaps. Set climb thrust and set flaps up. Accelerate to en-route climb speed.

NB: If you are using a joystick with throttle control, move the throttle control fully forward while the engines are spooling up. If less than full throttles position is set, the autothrottle system may hold the position of the joystick throttles and not select the desired power if the is in idle power position. This is a limitation of the PC hardware.

Climb and Cruise

Climb at max climb speed of 340 KIAS / M 0.84 after passing FL 100. On reaching cruise level, fly the speed appropriate to the aircraft weight and flight level, as provided in the performance tables.

Monitor fuel levels during the cruise and compare the burn with your precalculated data.

Descent and Approach

Before starting descent, review the approach for the destination airport and check your approach briefing. Review all fault messages. Verify the Vref speed, and set DA or MDA for the selected approach. At the transition altitude, set all altimeters to the local pressure setting.

Before intercepting the approach track, extend flaps in steps to 1, 5 and 10. Intercept the approach track with flaps 10 and gear up. Once the glideslope comes alive, select gear down and set flaps 20. On glide slope intercept select landing flaps. Once the glideslope is captured, set the missed approach altitude on the MCP.

If you are flying the approach with the automatic flight control system, use the same steps as mentioned above. Make sure that the ILS is active on NAV 1. Observe the autoland status at and before decision height.

Missed Approach and Go Around

If you need to go around, push the TOGA switch and set flaps 20. Verify rotation to go around attitude and thrust increase, if necessary increase it manually. Once a positive rate of climb has been established, select gear up. Time permitting, you can reprogram the route for the missed approach, but be prepared for manual navigation (HDG/VOR) in a go around situation and brief accordingly. Above 1000 ft RA, set FL CH. Call for flap retraction according to schedule. Call for the „After Take Off Checklist„ and continue with normal climb procedures.

Landing Roll

Once on the ground, initiate reverse thrust without delay. Verify the thrust levers are closed and the speedbrake lever is up. By 60 knots start reduction of reverse thrust in order to reach idle reverse before reaching taxi speed. Disengage autobrakes prior to reaching taxi speed and continue to brake manually. Engage nosewheel steering whenever necessary but at the latest when turning off the runway.

Part 4 Emergency and Abnormal Procedures

Abnormal Procedures

This section includes procedures for malfunctions and problems that may arise in flight. In the event of a malfunction, it is paramount to fly the aircraft first, that means to keep the aircraft in a clear and safe flight path and ensure continuation of flight as well as possible in the circumstances. Only once that has been clearly established, a clear scheme of analysis and action must be put in force to deal with the emergency.

It is one of the „shortcomings„ of most PC based flight simulators that we are talking here of a single crew environment as opposed to the normal multi crew environment on the real plane. This has been taken into account when designing the systems of the simulated aircraft . Many assisting pilot jobs have been cut in order not to overload the PC Pilot with tracking and analysing the problem while still trying to fly the aircraft. For the same reason, the number of possible failures has been limited to failures that primarily affect flying, while simple system faults that require nothing but switch throwing, have been omitted.

Generally, when dealing with abnormal procedures and malfunctions, the scheme PPAA works well. Unless you use an alternative, it is recommended that you use this basis.

Power	Make sure that power is available to keep flying. Increase power if necessary to MCT or MTOP.
Performance	Make sure that any drag related features are in their proper configuration, such as gear, flaps and spoilers. The more drag you have, the less performance the aircraft will give you.
Analysis	Asses the situation and set the necessary priorities.
Action	Once you are clear on what your problem is, begin action according to the abnormal/emergency checklists and good airmanship. Create favourable conditions in regard to selection of landing field, ATC, and cabin.

With good planning, carried out efficiently and quickly, you will find dealing with emergencies and anomalies can become a challenge rather than nightmare.

B747-400 EMERGENCY PROCEDURES

REJECTED TAKEOFF

Above 80 knots and prior to V1 the following is immediately accomplished in the event of an engine failure, engine fire, unsafe configuration or any adverse condition significantly affecting the safety of flight.
Prior to 80 knots the takeoff should be discontinued for any of the above conditions or activation of the master caution light.

1. Call aborting and simultaneously close the Thrust levers, disconnecting the autothrottles and apply maximum manual wheel brakes or verify the RTO autobrakes operating.
2. Select reverse thrust symmetrically.
3. Raise speedbrakes if they have not operated automatically.
4. Advise ATC of reject action.
5. When through 80 knots and field length permitting initiate appropriate procedures or actions as required by the rejection.

ENGINE FAILURE AFTER V1

At Vr	Rotate Smoothly to Target Pitch Attitude. Maintain Yaw control by use of rudder pedals.
Positive Rate of Climb	Gear Up Maintain V2 to V2 + 10

Engine Acceleration Height (normally 1500') Level acceleration, retracting flaps on flaps/speed schedule.

Flaps up	Climb at Flaps 0 speed + 20 knots to Obstacle clearance altitude (Normally sector safe altitude). Set MCT thrust.

APPROACH AND LANDING WITH ONE ENGINE INOPERATIVE

With one engine inoperative there is no difference in procedures from that of a four engine approach and landing. Just remember to maintain the aircraft yaw control with rudder pedals/trim.

ILS TWO ENGINES INOPERATIVE

TWO ENGINES INOPERATIVE

Autothrottles inoperative.
Use flaps 25 and Vref25 for landing.
Use flap1 for go-around: **Committal point is gear extension.**
Plan to fly final approach with gear down and flap 10.
Plan to extend flaps to 20 at 500' AGL and flaps to 25 when touchdown target is assured.
Set rudder trim to zero prior to touchdown.

ILS TWO ENGINES INOPERATIVE

1. Approach preparation	- Complete two engine inoperative check list - reduce weight as required (note that the B747-400 can fly a comfortable two engine operation at max landing weight.)
2. Intercept heading	- Flap 5
3. Established LOC and G/S active	- Flaps 10
4. Glideslope intercept	- Gear down - Complete landing checklist to final flaps. - **DO NOT ATTEMPT A MISSED APPROACH AFTER LANDING GEAR IS EXTENDED**
5. At 500 feet agl	- Flaps 20
6. Touchdown Target Assured	- Flaps 25 - Complete landing checklist
7. After touchdown	- All reverse levers UP - Reverse thrust on symmetrical engines
8. **Missed Approach**	- Go-around thrust commensurate with directional control. - Retract Flaps to Flaps 1 on schedule. - Climb at Flaps 1(Vref +60) speed (If required)

FLAPS 0 APPROACH AND LANDING.

No procedures listed for this action. The flap system is well catered for with four hydraulic systems, 4 electrical and pneumatic air backups.

NON NORMAL PROCEDURES

ENGINE FAILURE/SHUTDOWN

Condition:	Engine Failure or flameout
Thrust Levers.........	CLOSE
Fuel Control..........	CUTOFF

MULTIPLE ENGINE FLAMEOUT or STALL

Condition:-
- Engines have flamed out, or
- have abnormal indications or exceed limits, or
- make abnormal noises, or
- respond abnormally to thrust lever movement.

Fuel Controls (Affected engines).......... CUTOFF
Clears a stall condition

Fuel Controls (affected engines).......... RUN

ENGINE - SEVERE DAMAGE, or SEPARATION

Condition:-	Airframe vibration with abnormal engine indications
Light:-	Respective fire switch and fuel control switch.
Thrust Lever.................	CLOSE
Fuel Control SW.............	CUTOFF
Engine Fire SW..............	PULL

If high airframe vibration occurs and continues after engine shutdown:

Without delay, reduce airspeed and descend to a safe altitude which results in an acceptable vibration level. If high vibration returns and further airspeed reduction and descent is not practicable, increasing airspeed may reduce the vibration.

FIRE ENGINE

Condition:-	Engine fire condition detected, or Turbine Overheat detected.
Light:-	Respective fire switch and fuel control switch.
Aural:-	Fire Bell
Thrust Lever.................	CLOSE
Fuel Control.................	CUTOFF

ENGINE(S) OUT OPERATION

FLY THE AIRCRAFT

Speed/Thrust.................	MONITOR
Trim.........................	ADJUSTED
VNAV.........................	ADJUST

If descent required:

MCP.......................... RESET/PRESS (Altitude window)

CAUTION
If VNAV not available, select THR and use VERT SPEED

If fuel/terrain critical:

FMC..........................	SELECT ENGINE OUT SPD
QRH Items....................	COMPLETE
ATC..........................	ADVISE
Navigation...................	CONSIDER TURN OFF TRACK
Fuel.........................	CHECK,MAINTAIN BALANCE/SCHEDULE.

Complete TWO ENGINES INOPERATIVE checklist if appropriate.

ENGINE IN-FLIGHT START

Condition:- Following a flameout or shutdown when no fire or apparent damage has occurred

CAUTION
Inflight restart on an engine intentionally shutdown, should only be attempted if the PIC considers the action to be necessary to preserve the safety of the aircraft.

Refer to in-flight start envelope below.

Monitor EGT during engine start.

Thrust Lever.................	CLOSED
Start Switches	ACTIVATE

In-flight Start envelop:-

Min 240 KIAS up to and including FL200 and 280 KIAS to FL300.
For Starter Assist any airspeed to FL140 till minimum 160 KIAS which is valid to FL180, thence minimum 200 KIAS to FL280.
Windmill Start is VMO/MMO to FL300.

PASSENGER EVACUATION

Condition:- Evacuation of passengers and crew is required

Parking Brake................ SET

Fuel Controls(All)........... CUTOFF

(Shut down engines as soon as possible to reduce the possibility of slide damage or personal injury.)

Outflow Valve Manual SWS..... ON

Outflow Valves Manual Control....................... OPEN

Passenger Evacuation......... INITIATE

Initiate the passenger evacuation by using the Passenger Address system. It is recom-mended that PA is selected and Boom/Mic microphone used in preference to the hand set.

Captain will order the particular method of evacuation he considers relevant to the situation, notifying cabin attendants of any conditions that may effect evacuation e.g.:high winds, irregular ground conditions and/or structural damage areas. For emergency evacuation use words EVACUATE, EVACUATE using the PA system.

Engine Fire SWs.............. PULL AND ROTATE
Rotate to the stop and hold for one second
(Rotate all engine fire SWS in the same direction.)

APU Fire SW.................. OVERRIDE, PULL AND ROTATE
Rotate to the stop and hold for one second.

Fuel Levers CUTOFF

Notify Tower of passenger evacuation.

JAMMED STABILISER LANDING

Condition:- Stabiliser fails to trim

LANDING PREPARATION:

Use Flaps25 and VREF30 + 20 for landing.

Operation with Unreliable Airspeed

The airspeed information can become unreliable for a number of reasons. Failure of instruments, air data computer and other information may lead to unreliable IAS, MACH, the various overspeed warnings e.t.c. This is a quite serious threat to safety. In such cases, only attitude flying and power setting can solve the problem.

Plan and fly the flight with the following configuration and power settings:

B747-400 Flight with Unreliable Airspeed

Phase	Flaps	FL	Apprx Speed	GW lb	Attitude	EPR	ROC/D
Climb	0	S.L	290	441	14 ANU	MAX CLB	6500
				661	11 ANU		4100
				860	10 ANU		2800
		100		441	10 ANU		5400
				661	8.5 ANU		3300
				860	8.4 ANU		2200
		200		441	7.5 ANU		4100
				661	6.5 ANU		2400
				860	6.5 ANU		1400
		300		441	4.7 ANU		2700
				661	4.5 ANU		1400
				860	4.8 ANU		500
Cruise	0	350	M 0.84	441	1.1 ANU	1.43	0
				551	1.8 ANU	1.48	
				661	2.5 ANU	1.55	
				772	3.2 ANU	1.68	
Descent	0	300	290	441	1.7AND	Idle	2400
No Spoilers				661	0		2000
				772	1.1ANU		2000
		200		441	1.8AND		2200
				661	0.5ANU		2000
				772	1.2ANU		1800
		100		441	2.0AND		2000
				661	0		1800
				772	1.2ANU		1700
Holding	0	100	240	661	5.3ANU	1.2	0
			220	551	5.1ANU	1.17	
			210	441	4.6ANU	1.14	
Approach	0	50	240	661	5.9 ANU	1.18	0
Level Flight			210	441	5.0 ANU	1.12	
	1		220	661	7.4ANU	1.21	
Gear Up			190	441	6.6ANU	1.14	
	5		200	661	8.3ANU	1.25	
			170	441	7.6ANU	1.17	
	10		180	661	8.9ANU	1.29	
			150	441	8.7ANU	1.19	
	20		170	661	8.0ANU	1.29	
			140	441	8.0ANU	1.19	
Final App.	20	SL	168	661	5.1ANU	1.15	900
3 deg GS			137	441	5.1ANU	1.1	750
	25		174	661	2.6ANU	1.18	900
			142	441	2.6ANU	1.12	750
	30		167	661	1.4ANU	1.23	900
			136	441	1.4ANU	1.16	750

Emergency Checklists

CONTENTS:

ITEMS WITH A * IN FRONT ARE MEMORY ITEMS!

ALL ENGINE FLAME OUT

*1 DESCENT TO FL 300 or below	INITIATE
*2. MCP SPEED	VMO/MMO
*3. THROTTLES	IDLE
4. Oxygen Masks	As Required
5. Nearest Airfield	Locate
6. ATC	Inform

RESTART ATTEMPT (2 per engine)

1. Engine Starter Switch	ON
If Engine Restarts	
2. Power	Apply
3. Other Engines	Restart

If one or more engines restarted, continue descent and land at nearest available airfield.
If no engine restarted, then go to EMERGENCY LANDING Checklist

ENGINE FIRE IN FLIGHT /or severe Damage / Separation

*1. Affected Engine(s)	Identify
*2. Affected Throttle Lever(s)	Close
*3. Affected Engine Shut Off Switch	Close

*4. DO NOT ATTEMPT RESTART UNLESS SITUATION DEMANDS IT ABSOLUTELY
*5. LAND AS SOON AS POSSIBLE

ENGINE FAILURE IN FLIGHT

*1. Affected Engine	Identify
*2. Affected Throttle Lever	Close
*3. Power on Good Engines	MCT or As Required

RESTART ATTEMPT

1. ALT Below FL300 / Speed Vmo/MMO	SET
2. Engine Starter Switch	ON
If Engine Restarts	
3. Power	Apply

ENGINE FIRE ON GROUND

1. Affected Engine	Identify
2. Engine Shut Off Switch	OFF
3. Fire Handle if Available	Pull

If Fire Persists

4. Park Aircraft into the Wind
Perform On Ground Emergency Checklist.

ENGINE RESTART IN FLIGHT

1. ALT Below FL300 / Speed Vmo/MMO	SET
2. Engine Starter Switch	ON
If Engine Restarts	
3. Power	Apply

ONE ENGINE INOPERATIVE (OEI) OPERATION

1. Nearest Suitable Airfield	Determine
2. ATC	Inform
3. Perform Normal Descent, Approach and Final Checklist.	

FLIGHT WITH 2 ENGINES OUT

- Select next suitable airport and perform descent
- Reduce weight to maximum MLW
- Use Flap 1 for intermediate approach until established
- Use Flap 10 for final approach
- When landing is assured select gear down
- Set flaps 20 at 500 ft
- Set flaps 25 when touchdown on runway is assured
- After touchdown apply reverse on symmetrical engines

FLIGHT CONTROLS

Stabiliser Trim Runaway

*1. Autopilot	OFF
*2. Manual Controls	Check
*3. Manual Trim via Keyboard	Check

If problem persists:

4. Controls	Disconnect(ALT J)

If problem is solved:

5. Autopilot	Engage
6. Continue with Jammed Flight Controls Checklist	

STABILISER / AILERON / RUDDER JAMMED

*1. Autopilot	OFF
*2. Manual Controls	Check
If Problem Persists:	
*3. Joystick Disconnect	ALT J
4. Autopilot	ON
5. Continue Flight to a ILS CAT III equipped Airport.	

EMERGENCY LANDING AND EVACUATION

COCKPIT EMERGENCY LANDING

Preparation:

1. Distress Call
2. Select Landing Place
3. Brief FA / PAX
4. Reseating
5. Secure Cockpit loose Equipment
6. Burn Fuel as Situation demands
7. Life Vests ON (Ditching only)

DESCENT / APPROACH

Flap Setting for Approach and Landing 30°

1. Approach Briefing	Completed
2. Seat Belts	ON
3. Altimeters	Set
4. Landing / Ditching / Evacuation Briefing	Completed

Landing Procedures with Gear Malfunctions:

Nose Gear Up:

1. Seat Passengers Aft, check CG
2. Touch down normally
3. Keep Nose high
4. Lower Nose before Elevator Effectiveness is lost.
5. Use maximum braking once Nose is down.

1 Main Gear Up rest down:

1. Sidewards Clearance about 250 m
2. Seat Pax near emergency exit
3. Hold unsupported wing high, do NOT use Spoilers.
4. Maintain directional control with rudder and nose gear steering.
5. When wing touches the ground, apply brakes for directional control.

Belly Landing (or Nose Gear down only)

1. Seat Pax near emergency exit
2. Touch down with minimum sink rate and speed. Do NOT stall.

Before Landing / Ditching

1. Gear	Landing:	Down or up at PIC discretion
	Ditching:	Up.
2. Radio Altimeters		Set
3. Flaps		Set 30°
4. Spoilers		Armed when not landing with one main gear up.
5. Brace for Impact Signal		1 Minute before Landing.

On Ground Emergency Checklist

CAPTAIN:

1. Park Brake	Set
2. Evaluate Situation	
3. Inform ATC	
4. Evacuation Order	Yes: Given No: „Passengers and Crew keep your seats"

FO:

1. Engine Shut Down Switches	Closed
2. Fire Shut Off Switches	Both pulled and discharged
3. Emergency Lights	ON
4. Battery	OFF
5. Flaps	DOWN

EVACUATE

Part 5 Performance

General Procedures and Tables

Operating Limitations

The following limits apply to the normal and abnormal operation of the airplane.

Altitudes

Maximum Altitude	45'100 ft
Flaps	20'000 ft
APU	20'000 ft
Max Field Elevation TO/LD	10'000 ft
Threshold crossing	42 ft

Speeds

Gear Extension	270 KIAS 0.82
Gear Extended	320 KIAS 0.82
Gear Retract	270 KIAS 0.82
Vmca 1 engine out	124 KIAS
Vmca 2 engines out	161 KIAS
Vne / MMO	365 KIAS 0.92
Rough Air Penetration	290 KIAS 0.82
Maximum Tire Speed	204 KIAS

Autopilot Engagement

After Take Off	250 ft AGL
Non Precision Approach	50 ft below MDA

Wind Components
(Speeds in KTS, Tailwind,Crosswind, Headwind)

	TW	CW	HW	
CAT III and III approaches		10	10	25
Autoland CAT I	19	25	25	
Braking action	good	10	30	
	fair	5	15 take off 10 landing	
	poor	4	10 take off 5 landing	
	nil or unreliable: Not authorised.			

Engines

EGT	Start	535 deg C
	Take Off / GA	650 deg C to 5 min
	MCT	625 deg C
N1		111.4 %
N2		105.5 %

Fuel

Imbalance	Total 2-3 to total 1-4	6000 lb
	tank 1 to tank 4	3000 lb
	tank 2 to tank 3	6000 lb

Fuel Jettison: Prohibited with flaps 1 to 5.

Landing Minimum 11'100 lb

Take Off

The basic take off speeds for flaps 20 take off setting are all provided in the PERF section of the NOMIS 2900V FMC. For completeness sake, here the basic speeds and weight for the flap settings provided.

CAUTION:
The speeds provided in the FMC are based only on balanced take off under standard conditions. The FMC speeds are therefore only of an advisory nature and MUST be verified before every take off.

Basic Take Off Speeds RB 211-524 G

Weight

1000 lb	485	507	529	551	573	595	617	639	661
683	705	728	750	772	794	816	838	860	872
V1	123	123	123	123	123	123	123	127	130
133	136	139	142	145	148	150	153	154	156
Vr	123	123	123	124	127	131	135	139	142
145	149	152	156	158	162	164	167	169	171
V2	143	143	143	143	146	149	152	155	158
160	163	166	169	171	174	176	178	180	181

Conditions: ISA, Sea Level, 15 deg C, Wind Calm.

Wind Correction: V1

Weight	Wind kts					
1000 lb	-15	-10	-5	10	20	30
872	-6	-4	-2	1	1	2
772	-6	-4	-2	1	1	1
661	-5	-3	-2	0	1	1
551	-5	-3	-2	0	1	1
485	-3	-3	-2	0	1	1

Altitude Correction, V1, Vr, V2

Weight	1000 lb				
Elev	485	551	661	772	882
1000 ft	1	1	1	1	1
2000 ft	2	2	2	2	3
3000 ft	3	4	4	4	4
4000 ft	4	4	5	5	5
5000 ft	4	5	5	5	5

Temperature Correction V1, Vr, V2

1000 lb	15	20	30	40	50	60
872	0	1	2	4	7	9
772	0	1	2	4	7	9
661	0	1	2	4	7	9
551	0	1	2	3	6	8
485	0	1	2	3	5	7

Minimum Speeds: V1: 123 Vr: 123 V2: 143

Instructions:

Determine basic speeds on the first table. Add or subtract wind correction, observe minimum speeds. Add altitude correction. Add Temperature correction.

Take Off Distance and Take Off Weight

In real life, take off weight for runway length, second segment and obstacle are presented in so called Individual Runway Tables or IRT's. Each runway on each airport an airline operates to will get 2 IRT's which will give you maximum take off weight for a given runway under given conditions.
In this manual however, doing this for the better part of several 100 airports would be way over the top! Apart from the fact that not many people would like to look up their respective TOW in a 1000 page book (or more, if I counted right) certainly not a lot of customers would be prepared to pay double the amount just for take off weight calculations on 2 airplanes.

So instead, we developed a table system that will still allow you to get sensible take off weights for any given runway, but in a more generalised manner. However, those of you who have access to real life IRT's, can use them without any problem with the planes of AS2.

Restrictions and deductions:

Runway length corrections for contaminated Runways:
Shorten actual runway length for calculation purpose by the factors given below.

WET: 100 meters
ICE: 900 meters

Obstacles: Use Obstacle Limit if obstacle is within 10'000 meters after runway end.

Crosswind Limitations:	DRY/WET/DAMP Runway:	30 kts
	ICE:	5 kts

Crosswind Table

Speed	10°	20°	30°	40°	50°	60°	70°	80°	90°
5 kt	1	2	2	3	4	4	4	5	5
10 kt	2	3	5	6	7	8	9	9	10
15 kt	3	5	7	9	11	13	14	14	15
20 kt	3	7	10	13	15	17	18	19	20
25 kt	4	8	12	16	19	22	23	24	25
30 kt	5	10	15	19	23	26	28	29	30
35 kt	6	12	17	22	26	30	32	34	35

IRT 1 REFERENCE AIRPORT

Take Off Weight Table B747-400 RB211-524H Engines All weights in LB ELEV 500 ft

FLAPS 20	Runway Lenght Limit /2nd Segment Limit					
RWY lenght	OAT °C					
HW/TW corr	0	6	14	24	36	44
2200 m	717.8	711.4	703.3	693.1	662.9	N/A
TW-	5'512	5'512	5'512	5'732	5'732	5'952
HW+	1698	1698	1698	1698	1477	1455
2400 m	745.4	739.2	731.3	721.3	688.9	658.3
TW-	5512	5512	5512	5732	5732	5952
HW+	1698	1698	1698	1698	1477	1455
2600 m	771.4	764.6	756.0	745.8	714.3	680.8
TW-	5512	5512	5512	5732	5732	5952
HW+	1698	1698	1698	1698	1477	1455
2800 m	797	790	781	770	742	703
TW-	5732	5732	5732	5952	5952	6173
HW+	1764	1764	1764	1543	1543	1543
3000 m	820.6	813.5	804.5	793.4	758.8	724.2
TW-	5952	5952	5952	5952	5952	5952
HW+	1830	1830	1830	1830	1830	1830
3200 m	844	836	828	815	780	744
TW-	5732	5732	5732	5732	5732	5732
HW+	2205	2205	2205	2205	2205	2205
3400 m	876	864	849	828	800	762
TW-	6989	6989	6989	6989	6989	6989
HW+	1323	1323	1323	1323	1323	1323
3600m	892.9	888.0	878.5	862.0	821.0	780.4
TW-	6614	6614	6614	6614	6614	6614
HW+	1323	1323	1323	1323	1323	1323
3800 m	892.9	892.9	892.9	885.6	838.9	798.5
TW-	6614	6614	6614	6614	6614	6614
HW+	1323	1323	1323	1323	1323	1323

Altitude Correction: **Obstacle Correction:**

Pressure Alt	Correction:	Pressure Alt	Correction:	Obstacle:	Gradient %	Correction
0	3.4	2800	-42.0		0.5	-20.4
200	1.7	3000	-45.5		1.0	-25.8
400	0	3200	-49.0		1.5	-38.2
600	-3.5	3400	-52.5		2.0	-45.8
800	-7.0	3600	-56.0		2.5	-55.2
1000	-10.5	3800	-59.5			
1200	-14.0	4000	-63.0			
1400	-17.5	4200	-66.5	2nd Segment		
1600	-21.0	4400	-70.0		0	882.0
1800	-24.5	4600	-73.5		6	882.0
2000	-28.0	4800	-77.0		14	882.0
2200	-31.5	5000	-80.5		24	882.0
2400	-35.0	5200	-84.0		36	882.0
2600	-38.5	5400	-87.5		44	872.5
		5600	-91.0			

TAKE OFF WEIGHT CALCULATION TABLE TOW BY IRT

B747-400 RB211	Registration:	Flt Nr:
AIRPORT	RWY	DATE

Met Information: Wind:_____°/____kt OAT:_______°C QNH:____
Corrected Runway Lenght:________m DRY: WET: ICE:
Wind: Maximum Crosswind :______ kt Head/Tailwind:_________kt
Crosswind: _________kt

TOW vs RWY LENGHT: FLAPS 20

TOW 0 WIND

Head/Tailwind ______x______kt

Altitude Correction: _

Corrected TOW A

ALL WEIGHTS IN LBS

TOW vs. OBSTACLE

TOW 0 WIND

Gradient ________% Correction: _________

Head/Tailwind ______x______kt

Altitude Correction

Corrected TOW B

TOW vs 2nd SEGMENT: C

MAX PERMISSIBLE TOW

TOW vs RWY LENGHT	A	
TOW vs OBSTACLE	B	
TOW vs 2nd Segment	C	
MTOW		882'000

Permissible TOW

THIS SHEET TO BE FILLED IN BEFOR ANY TAKE OFF IS ATTEMPTED!

(Gradient is calculated as follows: obstacle height (m) / distance from runway end (m) * 100)

Climb

Time & Distance to Climb

ISA Conditions

FL	250	270	290	310	330	350	370	390	410	430
GW 1000 lb	tt dist	tt dist	tt dist	tt dist	tt dist	tt dist	tt dist	tt dist	tt dist	tt dist
881840	18/103	19/118	21/134	24/154	28/188					
859794	19/97	19/112	20/127	22/145	26/173					
837748	16/92	18/106	19/119	21/135	24/158	30/210				
815702	15/87	17/101	19/114	20/128	23/148	27/184				
793656	15/82	16/96	18/108	19/122	21/138	25/168				
771610	14/78	16/97	17/102	18/115	20/130	23/153	30/212			
749564	14/74	15/86	16/97	18/109	19/123	22/143	26/182			
727518	13/70	14/81	16/92	17/103	18/115	20/133	24/162			
705472	13/66	14/77	15/88	16/98	18/110	19/125	22/148			
683426	13/63	13/73	14/84	16/93	17/104	18/118	21/138	26/182		
661380	11/59	13/68	14/79	15/88	16/96	17/110	20/127	23/159		
639334	11/56	12/64	13/75	14/83	15/93	17/104	19/119	22/144		
617288	11/52	12/61	13/70	14/79	15/88	16/98	18/112	20/133	26/180	
595242	10/49	11/57	12/66	13/74	14/83	15/92	17/104	19/122	23/154	
573196	10/47	11/54	12/62	13/71	14/78	15/87	16/98	18/114	21/138	
551150	9/44	10/51	11/58	12/67	13/74	14/82	15/92	17/106	19/127	24/168
529104	9/41	10/48	11/55	12/63	12/70	13/78	14/87	16/99	18/117	22/146
507058	9/39	9/45	10/51	11/59	12/66	13/73	14/82	15/93	17/108	20/131
485012	8/37	9/42	10/48	10/55	11/62	12/69	13/77	14/87	16/100	13/119
462966	8/34	8/39	9/45	10/52	11/59	12/65	12/72	14/82	15/93	17/109
440920	7/32	8/37	9/42	10/48	10/55	11/61	12/68	13/77	14/87	16/101
418874	7/30	8/34	8/39	9/45	10/52	11/57	11/63	12/71	13/81	15/93
396828	7/28	7/32	8/37	9/42	9/48	10/53	11/59	12/66	13/74	14/85

Service Ceiling / Drift Down

Service Ceiling and Optimum Altitude

Weights in LB

FL	Opt Weight	Max Weight	
450	394623	462966	445329
430	434306	509263	496035
410	478398	559968	553355
390	526899	617288	615083
370	579810	679017	683426
350	637129	747359	747359
330	701063	820111	813497
310	769405	881840	879635

Drift Down

Weights in 1000 lb

Remaining engines at Max Continuous Power

	1 eng out	2 eng out	1 eng out	2 eng out	1 eng out	2 eng out
Start Weight	End Weight	End Weight	Opt IAS	Opt IAS	Level Off Alt	Level Off Alt
882	862	847	305	297	275	149
838	820	805	298	290	289	168
794	776	763	291	283	304	188
750	734	723	284	276	318	206
705	690	679	275	268	331	223
661	646	637	267	260	346	240
617	604	595	259	251	362	258
573	560	553	249	243	376	276
529	518	509	239	233	390	296
485	474	467	229	224	406	318
441	432	425	217	214	424	341

Descent

Time and Distance to Descent

FL	Dist ESAD	Time
450	144	22
430	138	22
410	132	21
390	126	20
370	120	19
350	114	19
330	106	18
310	99	17
290	91	16
270	84	15
250	77	14
230	70	14
210	63	13
190	56	12
170	49	11
150	43	10
130	35	9
110	28	8

Conditions: No Wind, Mach 0.84/285kt/250kt descent, Idle Thrust

Holding

Holding patterns have little significance in AS2. However, for planning purposes, sufficient holding fuel for 30 minutes must be planned. The table below gives you some indications on how to determine the necessary holding fuel.

Holding Fuel used per hour / all engines / flaps up

Gross Weight 1000 lb

FL	882	750	617	573	441
400				21252	14639
350			20811	18871	13845
250	29542	24251	19577	18078	13933
200	28748	24074	19753	18430	14639
100	28748	24339	20371	19048	15344
50	29101	25044	21164	19841	16226

For 30 minutes holding plan half of the above amount.

Landing

Flap Speed Schedule / Maneuvering

The following speed schedule is based on Vref 30.

Flaps Up	80
Flaps 1	60
Flaps 5	40
Flaps 10	20
Flaps 20	10
Flaps 25	Vref 25
Flaps 30	0

Instructions: Add the displayed speed to Vref30 of the below table.

Vref Table

Vref KIAS	Gross Weight 1000 lb							
	441	463	485	507	529	551	573	595
Flaps 30	127	131	134	137	140	143	146	149
Flaps 25	132	136	139	143	148	149	152	155

Landing Weight vs Distance

The calculation of exact landing distance and required field length is quite complex and not covered in this manual. However, as a guideline, you can use the table below to give you an idea of the runway requirements and maximum landing weights for different runways.

Landing Weight

FLAPS 25		ISA conditions		Dry Runway	No Wind
			Corrected Field Lenght		
Elevation	1700	2000	2400	2800	3500
0	440.0	518.0	617.2	630.0	630.0
2000	N/A	498.4	595.2	630.0	630.0
4000	N/A	462.9	562.1	630.0	630.0

FLAPS 30		ISA conditions		Dry Runway	No Wind
			Corrected Field Lenght		
Elevation	1700	2000	2400	2800	3500
0	440.0	551.0	630.0	630.0	630.0
2000	N/A	546.7	623.0	630.0	630.0
4000	N/A	489.4	584.2	630.0	630.0

Corrections:

Wind:
Headwind: Increase Corrected Field Length by 50 meters per 5 kt headwind.
Tailwind: Decrease Corrected Field Length by 100 meters per 5 kt Tailwind. Mind Tailwind Limit of 10 Kt.

Surface Conditions:
Dry Runway: Crosswind Limitation 30 kts.
Wet Runway: Decrease Corrected Field Length by 300 meters. Crosswind Limitation 30 kts
Icy Runway: Decrease Corrected Field Length by 750 meters. Crosswind Limitation 5 kts.

Flight Planning

Flight Planning for a heavy long range aircraft is quite different from planning a flight on a medium to short range plane. The main criteria in long range flight planning is weight. That is why all the following calculation are based on the Zero Fuel Weight and,after initial calculations, the Landing weight.

Before we start going into details, let me make you aware again of ATPUTIL 5.0. It is by far the easiest way to generate a flight planning for your flight. If of course you want to fly routes that are not really covered by ATPUTIL, you need to be able to do it by hand as well.

Before starting the calculation, you need to determine the route you will fly and the ground distance. Also determine your alternate airports.

Flight planning with this method requires several steps.

1. Determination of Zero Fuel Weight. — Determine the total payload you will be carrying and add the Dry Operating Weight.
2. Calculation of the Reserve Fuel. — Calculate your fuel requirements at the destination, that is Alternate, Holding and Contingency Fuel plus the minimum fuel on board or final reserve. Final reserve is always 11000 lbs. .
3. Determination of Landing Weight — Out of steps 1 and 2, determine the expected Landing Weight by adding ZFW and Reserve Fuel
4. Determination of ESAD — Determine the total ground distance for your flight and the wind component, then calculate ESAD.
5. Determination of Trip Fuel — Using the tables, determine the required trip fuel for your flight.
6. Add the Trip fuel to the Reserve Fuel — and receive the fuel needed for the flight.

Zero Fuel weight is determined by adding up DOW and Payload. Once you know how many passengers and cargo you carry on your flight, you can calculate the weight.

To calculate reserve fuel, first add the 30 minutes holding fuel. Use your Zero Fuel Weight plus the minimum fuel quantity on board of 11'000 lb to determine your probable weight for calculation.

Once you have found out the holding and minimum fuel, determine the ESAD to your alternate airport. Then find the corresponding fuel needed in the table below.

Alternate Planning (simplified) based on 600'000 lb Landing Weight

ESAD	Fuel	Time
100	8818	00:21
200	14330	00:36
300	18739	00:48
400	25353	01:00
500	27558	01:12

Corrections:
Deduct 10% of the alternate fuel for each 40'000 lb below 600'000 lb.

You now have found your primary landing weight prevision for the destination. It adds up as follows:

DOW
+Payload = ZFW

+Final Reserve
+Holding Fuel
+Alternate Fuel = +Reserve Fuel

Minimum Landing Weight at Destination

With this figure, you can now enter the table below for tripfuel and trip time. It must be stressed, that this way of flight planning is very much simplified.

Simplified Flight Planning Long Range Cruise

Based on: FL 330 or above, 340/.84 Climb, .84/290/250 descent.

Landing Weight	441	485	529	573	617	630	
Ground Dist	Fuel	Fuel	Fuel	Fuel	Fuel	Fuel	Time
ESAD							
1000	39.7	41.9	44.1	46.3	48.5	50.7	02:18
2000	80.5	83.8	88.2	92.6	101	104	04:24
3000	121	126	137	146	154	159	06:30
4000	170	176	185	198	212	220	08:30
5000	216	229	238	256	271	276	10:30
6000	265	278	291	309	326	331	12:42
7000	315	333	348	375	401	408	14:30

Simplified Flight Planning Mach 0.86 Cruise

Based on: FL 350 or above, 340/.84 Climb, .84/290/250 descent.

Landing Weight	441	485	529	573	617	630	
Ground Dist	Fuel	Fuel	Fuel	Fuel	Fuel	Fuel	Time
ESAD							
1000	41.9	41.9	44.1	46.3	48.5	50.7	02:06
2000	86	88.2	90.4	97	104	106	04:00
3000	132	134	137	146	154	161	06:00
4000	181	183	187	198	212	220	08:00
5000	216	229	238	256	271	276	09:54
6000	289	295	304	322	337	340	12:20
7000	346	357	364	386	430	434	14:00

Altitude Corrections:

For each FL below the Base level, add 6% of Trip fuel.

Contingency fuel: Contingency fuel is calculated as 15% of the trip fuel.

Now it is time to bring it all together.

B747-400 Dispatch Release Form

Flight	Aircraft	From	To	Alternate
Dep Time	Arrival Time	Flight Time	Ground Dist	Ground Dist

Wind Component

ESAD

Load Calculaton:

DOW	401000				
Payload					
Estimated Zero Fuel Weight				Max	543000
Reserve Fuel	Fuel	Endurance			
Final Reserve	11000				
Alternate					
Holding					
Additional					
Total Reserve		+			
Estimated Landing Weight				Max	630000
Trip Fuel		+			
Contingency		0+			
ETOW				Max	870000
Endurance					

Flight Level Selection

Select your flight level as high as possible. Initially, check in the FMC for the optimum level and do a climb to it. After each hour, recheck the optimum level and try to maintain it as close as possible.

Taking care of your Simulator:

The best simulator needs updating and care. Outside conditions and navigational aids change on a daily basis. We have provided some tools you can use in order to update, extend and adapt Airline Simulator 2 to your liking. In the Airline Simulator 2 group, you will find these utilities that are described below here.

ATP UTILITIES 5.0 „Where do you want to fly to tomorrow?„

ATP utilities is a a program that will make the update and maintenance of AS2 possible. It is a quite easy to use tool, however, you should take a moment to familiarise yourself with its operation.

ATPUTIL.EXE

Career Assignment Editor
Logbook Editor
Career Results Editor
Flight planner with Display/Print of Routes and detailed Fuel Calculation
Node, Route, Primary Airport and ATC Centre Editor

User Interface

General Rules of user interface:

End and Leave a form with ENTER or ESC, while not editing a field. If you want to edit a field, press F3. Press INS for inserting or DEL for deleting data. While showing Information, you may scroll down and up using Page_dn or Page_up (or click arrows with mouse).

Special Handling for Showing Career Results: (ATPUTIL)
You may alternate between normal flights and check flights by pressing 'SHIFT+Left Arrow' or 'SHIFT+Right Arrow'. This also applies for showing the frequencies of ILS's and Centres.

Special Handling for Lat/Long Co-ordinates:
In the Node, Primary and Centre Editor within ATPUTIL you may press 'grey +' ("+" on the numeric pad), when editing a co-ordinate field. A second window will be brought up, containing the Lat/Long. Co-ordinates, which may be edited. (see below).

Whenever you need help, press <F1> (available only after registration). A context sensitive, detailed help screen will appear. The whole users manual is available only through the help screens.

ATPUTIL5.0

ATPUTIL is the main servicing program for Airline Simulator 2. It includes:
- Career Assignment Editor
- Logbook Editor
- Career Results Editor
- Flight planner with Display/Print of Routes and detailed Fuel Calculation
Node, Route, Primary Airport and ATC Centre Editor

ATPUTIL Airport database:

You may add your own airport data to the file "AIRPORT.ATP", which contains the data of all airports available to ATPUTIL. The file can be edited with notepad or any text editor. On every line there is described one airport. First there is the code, then the location of the airport within parenthesis, then the runways which are controlled by ATC for landing, then ";" and the other available runways (but not controlled by ATC). After the "-" there are the co-ordinates and the altitude of the airport.

The database is used for a complete list of all Airports of a used flight area. All airport lists within AS2 (except list in primary edit menu) are based on this database.

The first 26 entries of "AIRPORT.ATP" (the primary airports) are automatically updated when primary airports are modified and updated. Due to lack of altitude information of primary airports, the airport altitude will be set to 0 at this time.

Flightplan:

The flight planner is available for every airport. It uses the Routes information of AS2, if both airports are primary airports. Otherwise it will find an IFR route, based upon airway information of ATPUTIL and the Nodes information of AS2.

The goals of the route finder are:
1) Find a connection based upon airways. There must be a VOR situated within 100 nm of both airports, which is the waypoint of at least one airway. The total distance of the found airway connection must not exceed 1.5 * straight line distance between both airports.
2) If step 1) fails, a route is searched only based upon Nodes information of AS2. Goals of that algorithm are:
   - There should always be contact with a VOR (if there is any chance).
   - The route should be as short as possible (but due to timing problems the finder will not find the best, but a good route, which may take up to 30 secs [486/25]).
   - The route finder does not know anything about airways or types of VORs.

You may choose a flight plan out of a career assignment (if a logbook is open, the next career-flight will be suggested) or input the airports manually. After manual input, no weather conditions are used within calculation. In career calculation, weather information within career file is used. You may view fuel results only after viewing routes.

Frequency Display:

After displaying the route information, which you left with ESC, a second screen will be shown with all necessary frequency information. Even the Centre frequencies you will be connected to, will be shown. The centres are identified at every node given within the route. The frequency display only appears, if AS2.EXE is identified by ATPUTIL (see above) and both airports are primary.

Fuel data:

Takeoff:	Fuel/time needed for takeoff and climbing 4000-5000ft AGL.
Departure:	Fuel/time needed until command to climb to cruising altitude.
Climb:	Fuel/time needed for climb to cruising altitude.
En route:	Fuel/time needed from reaching to leaving cruising altitude.
Descend:	Fuel/time needed for descent to far approach.
Approach:	Fuel/time needed from entering approach control zone to landing clearance.
Landing:	Fuel/time needed for final approach and reverse thrust.

All calculations are based upon experiences with AS2 and are optimise for AS2. They must not be used for real navigation. After choosing Fuel, the best calculation will be shown. You may choose other altitudes with Page_dn or Page_up.

NOTE: With reference to the weight and balance considerations mentioned above, you may use the following fuel figures to identify Trip Fuel (TIF) and Take Off Fuel (TOF):

Trip fuel equals the sum of all of the above mentioned fuel. The summary of these gives you the fuel used from take off to landing. Take off fuel will be the Trip fuel plus any reserve you choose to add. ATPUTIL shows you a fixed reserve fuel. However, you will need to make your own requirements clear. If the above reserve fuel is enough, go ahead and add it to the trip fuel to get take off fuel. If not, add the fuel you deem necessary for route reserve, alternate, holding and contingency and then add that sum to the TIF

Print Flightplan:

The flight plan can be printed by answering YES to the question "print ...". You will be given the opportunity after viewing route and frequency information (route and frequencies will be printed), and after viewing fuel (the fuel information is printed). There is no configuration for the used print device necessary, the printer needs to support CR (Carriage Return), LF (Line Feed) and FF (Form Feed). If the print device is a file, the output will be appended to the end of the file (so you may store a lot of flight plan and fuel information in one file).

Node Editor:

The node editor may hold up to 1020 nodes. If your PC does not have enough memory, the program may crash (unrecoverable error in the user interface library). The nodes database is for ATC use only. Therefore changes do not alter the scenery files (which means, that you will not see any new VOR, or position changes of VORs, while navigating in AS2).

ATC will guide you based upon the nodes and assume, that given VORs are located on the given positions and are working properly. If you want to edit a new NODES database, you have to clear NODES.BIN within Nodes menu.

Route Editor:

The route editor may only change routes between primary airports (altering ROUTES.BIN). The route editor is not capable of editing two routes between the same airports, regardless to direction of routing (the file must not exceed 60k), if there was only one route for both directions (which is the case in the default ROUTES.BIN). If you want to generate a new ROUTES.BIN, you have to clear routes within nodes menu, (NOTE: AS2 perhaps will lock up, if you try to start with an empty route file. At least the route from airport 12 to airport 23 must exist, you have to re-edit this route).

After finishing the route, ATPUTIL checks the given radials according to the locations of VORs and yells! if there is a deviation of more than 5 degrees. Then you may choose ATPUTIL to change the radials by themselves.

If there are only unidirectional routes, you may convert them to bi-directional routes by activating "Bidir. Routes" in menu NODES/PRIMARY. ATPUTIL checks for existence of one way routes and opens the return direction routing.

You also may to generate Routes automatically (for a full definition of routes you may need to define 650 Routes!). The automatic route generator uses the same algorithm as flight plan. See above for detailed description.

Primary and Centre Editor:

You may change all data of the primary airports. The sum of the length of all airport names must not exceed 254 Bytes (including a NULL Byte at the end of every name), also the runway table must not exceed its original length. ATPUTIL checks for this and refuses update of AS2.EXE, if an error is recognised. The data is: Location and direction of aircraft at terminal, location and direction of aircraft after autotaxi, several frequencies (approach=departure frequency), the controlled landing runways and uncontrolled runways.

Note, that the airport name may be a centre name, too. 10 Centres out of the primary airports must be chosen. Each centre consists of 4 sub areas, which are controlled on different frequencies. If the co-ordinates indicate to be within one control centre, but no sub area fits, the default frequency will be chosen. Default sub area always will be set to whole centre area co-ordinates at update, regardless of what you enter.

Import and Export of Primary airports:

ATPUTIL is able to interchange primary airports between several versions of ATP (as well as users) by exporting the primary airports and then importing
the resulting file to a new ATP. This feature can also be used to send primary airport configuration to other users without sending the EXE-File.

After selecting Export, ATPUTIL will ask you for the name of the file, which will store the primary airport configuration. You may enter a path and file-
name with extension (as in DOS). ATPUTIL will then write all primary data including centre data to that file.

After selecting Import, you may enter the file name including path and extension (as in DOS), where ATPUTIL previously stored primary configurations.
ATPUTIL will then read all data. NOTE: You must select Update , before the new primaries come in effect for flights.

Lat/Long. Co-ordinates:

In the node, primary and centre editor you may use Lat/Long co-ordinates instead of the AS2 Co-ordinates. Enter the co-ordinate field (North or East), then press the 'grey +' key ("+" in the number block). A window with Lat/Long. Co-ordinates will appear. Change the data, press ENTER. The window will close and both AS2 Co-ordinates will be updated according to the Lat/Long. data. The correct transformation will be identified by Line 2 of file "SCENERY.DAT":

0 .. ATP default scenery, IPS (ATP), California Collection (ATP) (No longer supported)
1 .. Japan Scenery (FS4)
2 .. GB Scenery Collection (ATP) (no longer supported)
3 .. Hawaiian Adventure Scenery (FS4)
4 .. USA East/West (ATP)
5 .. Europe (AS2) - used for AS 2 Default and Italian and Swiss Sceneries

Archive:

This set of functions allows you to efficiently administrate several sets of ATC environments (e.g. for AS2 default, ATPUK2, SUNAIR, etc.). The archive will store following data:

- Primary Airports including centres (ATP.EXE, FOREIGN.ATP)

- CAREER.ATP	ATP File - storing all career assignment orders
- NODES.BIN	ATP File - storing all nodes used for routing
- ROUTES.BIN	ATP File - the route information
- AIRPORT.ATP	ATPUTIL File - List of Airports available for Flight planner
- AIRWAY.ATP	ATPUTIL File - List of all airways for automatic routing
- ATC.VC1	ATP File - Voice File for ATC
- ATIS.VC2	ATP File - Voice File for ATIS

The archive also allows transfer of data between computers by providing export/import functions.

The main functions are:

Save Archive:	Saves the present ATC environment.
Recall Archive:	Recalls a previously saved ATC environment.
Export Archive:	Creates an Export file you may use make your new environment available to others.
Import Archive:	Imports a previously created Export file.

Refer to online help regarding exact usage of the Archive.

Adapting AS2 for a new scenery:

If you want to generate ATC routes for different sceneries, you will have to perform the following steps:

1.) Using the ARCHIVE Option, archive your present AS2 environment. It is recommended that you also export your present AS2 environment and store it separately.
2.) Edit Primary Airports You will have to install airports of the new scenery as primary airports.
3.) Edit ATC Control Centres.
4.) Generate a new AIRPORT.ATP File, according to above description. Be sure to enter the primary airports in the first 26 lines in correct order, then the secondary airports.
5.) Generate a new NODES.BIN and a new ROUTES.BIN.
6.) Edit the NODES within AS2UTIL.
7.) Edit the ROUTES within AS2UTIL (you will have to edit the nodes first!) NOTE: The route from airport 12 (=LAX in USA scenery) to airport 23
(=SFO in USA scenery) must exist, otherwise AS2 may lock up in the demo flight at the start.
8.) Alter the career assignments to the new airports as you want them
9.) Do automatic flights: Automatic departure from every primary airport.
Automatic arrival at every primary airport.
Ideally. check all routes for correct behaviour.
Be aware, that automatic flights will have problems if intersections (nodes not a VORs) are involved in the routing, and AIRLINE.DRV is not installed (refer to AIRLINE Support below).
10.) Save and export the new environment. Don't forget to contribute your new Archive to CompuServe's SIMPILOT forum for the benefit of other users.

Scenery read:

ATPUTIL automatically reads the sceneries North deviation. If ATPUTIL does not find the scenery or does not have enough memory for reading the scenery, no North deviation will be calculated (making differences of about -35 to +20 degrees).

Possible error messages with scenery read problems:

Illegal Scenery Code encountered	Contact Author - severe problems, reinstall original scenery
No matching area found	There was no area matching the given location, therefore no North deviation can be used - continue work. This problem often occurs, if using VORs located in "grassland", where no city or airport is located nearby.
SCENERY.DAT not found	The configuration file is missing - exit ATPUTIL and create file.
Scenery files not found	The path or filename given in SCENERY.DAT does not match. - exit ATPUTIL and correct. (Edit SCENERY.BAT).
Not enough memory to process scenery.	1) Need at least 600 kB of free memory. - exit ATPUTIL and correct. 2) Earlier heavy action causing memory fragmentation. ATPUTIL is not able to locate a contiguous memory block large enough for scenery read. - restart ATPUTIL

AIRLINE support:

In pilots logbook menu, there is the facility to view a Simulated Airline (e.g. SUNAIR) orders and flight results as well as the possibility to create personal orders.

The Airline Driver allows additional functionality to AS2 for operation of a virtual airline. The original idea of this driver was CISAIR, which has ceased operation and merged with SUNAIR, which took over all operations.

The idea has been spread to several countries. Several Airlines - especially in Europe, Australia and Japan - have been founded, using versions of AIRLINE.DRV.

What are Virtual Airlines?

CISAIR (CompuServe Information Service Airline) was an initiative on CompuServe by Tom Lichtenberger. CISAIR attempted to simulate a real airline with all technical and commercial aspects of an airline operation. Due to internal administration troubles the airline merged with SUNAIR, which took over all operation on CompuServe. Contact SUNAIR via CompuServe's SIMPILOT Forum, Section Simulated Airlines.. The current president, who succeeded the founder of SUNAIR Jim Swanson (who unfortunately died in February 95), is Juergen Vollmer, CIS ID: 100014,330.

SUNAIR operates on Airline Simulator 2 and SubLogic's ATP (Airline Transport Pilot Simulator) and uses all subLOGIC sceneries. The airline owns at this time several aircraft from SHORT 360 to B747.

At this time the airline operates mostly on free flights and does not run assignments. Nevertheless SUNAIR plans to integrate assignment flights and AIRLINE.DRV controlled flights for regular checkflights in very near future.

Every registered pilot receives his check flight orders (contact Juergen for further details) via CompuServe E-Mail. After flying those flights the pilots returns the result files created by AIRLINE-Driver to the administration of SUNAIR, which evaluates those files for commercial as well as technical performance aspects and pilots ranking within airline.

Pilots as well as people interested in assisting with the administration of SUNAIR should contact Juergen Vollmer for registration via CompuServe's SIMPILOT forum

Tasks of AIRLINE Driver:

The main task of AIRLINE Driver is to monitor the pilots flying abilities. For this purpose it stores many aspects of flight, which are not evaluated by AS2s standard ranking:

- airborne time
- touchdown time
- Exact location of touch down
- Airspeed at touch down
- Vertical speed at touch down
- Heading at touch down
- Tuned NAV radios
- Maximum banking during flight
- Maximum positive pitch during flight
- Maximum negative pitch during flight
- Fuel before takeoff
- Fuel after landing
- AS2 rating
- AS2 flight error list

The AIRLINE driver also checks for correct login to a flight. A flight only can be made for an AIRLINE, if the correct password is entered at the beginning of a single assignment. Pilots will be given a chance to enter the password, if the selected assignment number (no separate choice of departure and destination) matches the assignment number stored within the order. Once the pilot has logged into a flight, the flight can not be started again - the pilot need to do the flight until successful landing.

The third purpose of AIRLINE.DRV is to manipulate weather conditions. It is able to change weather parameters:
- Turbulence: none, light (factor 1), heavy (factor 4)
- Create Thunderstorms (3000 ft to 31000 ft AGL, widely spread)

The AIRLINE Driver will increase turbulence automatically by factor 1, if the aircraft is within a cloud layer or thunderstorm layer. Turbulence will decrease near ground, but not disappear. Thunderstorms and Turbulence appearance and duration are driven by random and may appear with and without forecast.

The last function of the AIRLINE driver is to provide aircraft failures, which may occur at random:

- Failure of ASI (Airspeed Indicator)
- Failure of ALT (Altimeter)
- Failure of ADI (artificial horizon)
- Failure of VSI (Vertical Speed Indicator)
- Failure of NAV2
- Loss of one engine
- Loss of all engines
- Failure of Gear (can not be locked)
- Loss of fuel
- Failure of Flaps (can not be operated anymore)

The chance of a failure increases with reduced reliability of aircraft. A failure of an aircraft system will not be signalled by alarms (neither via alarm tone or alarm message). The only sign of failures occurring is a redraw of the instrument panel during flight.

Installation of AIRLINE-Driver:

Add the line DRIVER=AIRLINE.DRV as the last line to the file "CONFIG.ATP" in the AS2 directory (using a standard text editor like EDIT or Notepad or similar).

Usage of AIRLINE.DRV:

For regular use of AIRLINE.DRV you also need to download and integrate files that SUNAIR or others will provide in their SIMPILOT Forum Section. These files need to be unchanged until another upload by SUNAIR administration. Copy those files to your ATP directory. By using ATPUTILs function Import primary airports and updating the files your ATP.EXE will be updated correctly to have all necessary information about SUNAIR airports.

Later on you'll receive order files by SUNAIR Administration. These files will arrive via E-Mail. Copy those files to your ATP directory and PKUNZIP them:
They will be named "SIMONxx.CIS", if pilots name is Simon, while xx is a counter of that files. Before starting ATP to do a SUNAIR flight you need to rename the next unzipped file to "AIRFLT.CIS" (REN SIMON01.CIS AIRFLT.CIS).

Afterwards you may view the Orders with ATPUTIL (only showing the assignment number to be used by that flight) or start ATPs single assignment. After choosing the correct assignment number (option 1) the AIRLINE Driver will bring up a window with the necessary flight data:

- Pilots Name
- Aircraft Name
- Condition of Aircraft (chance of getting failures!)
- Departure Airport and Destination
- Additional weather information (turbulence, thunderstorms), which are not available from CAREER.ATP
- Comment for that flight by CEO (CISAIR Administrator).
- Flight Status: NOT TAKEN, if the correct password is not entered (you'll receive the password from the CEO)
  LOGGED IN, if the correct password was entered
- Hidden entered password

You now enter the password and confirm it by pressing the <ENTER> key. If the entered password is correct, the flight status will change to "logged in". If you mistype the password, you may use backspace to correct the password.
After logging into the flight, you continue by pressing the <ESC> key or abort the whole assignment by pressing the space bar.

Immediately after pressing <ESC> with flight status "logged in", the order file is updated for forbidding of repetition of the flight. You now have to fulfil your order - you must not switch off your computer or leave AS2 before having ended your flight.

After landing, the order file is updated a second time with all flight data. Now the order file changed to be a result file. This result file may now be viewed by ATPUTIL. The screen will display all the data that the airline Administration will see, too. Copy the file "AIRFLT.CIS" over the original order file
(COPY AIRFLT.CIS SIMON01.CIS) and prepare for the next flight. After doing all the assigned flights PKZIP all the result files (SIMONxx.CIS) to one file again and send it back to your Airline Administration via E-Mail.

Emergencies:

The AIRLINE-Driver may set up some aircraft failures, which may lead to emergency situation. You need to immediately land at next airport. In that case you need
1) abort ATC assignment (press CTRL-C twice)
2) abort assignment (select menu F1, Option 1 - free flight)
   (These two steps are comparable to declaration of emergency (MAYDAY) and clearing direct route to the airport and runway of your choice)
3) select the next airport of your choice and do your ILS approach

If the failure occurs before or during takeoff, if it is appropriate to abandon takeoff, do so. The AIRLINE driver will update the results after the aircraft comes to a full stop.

ATPUTILs View/Create AIRLINE:

ATPUTIL is able to display the assignment number of an order in AIRLINE order file. No other data are displayed at this time.

The Result file is completely displayed:
- Name of Pilot
- Password
- Name of Aircraft
- Reliability of Aircraft
- Assignment Number
- Turbulence during flight (None, light, heavy)
- Thunderstorms (YES/NO)
- "Commanded" Failures by Airline Administration
  (VSI ALT HOR VSI NAV2 1 Eng All Eng Gear Fuel Flaps - see tasks section)
- Time in seconds after logging in until failures occur
- Real occurred failures (see "commanded failures")

(commanded failures need not to occur, not commanded failures may occur)
- CEO Comment (Comment by Airline Administration)
- Airborne time
- Touchdown time
- message indicating if flight was finished or aborted
  LANDED, if aircraft was airborne and has landed again
  ABORTED if aircraft was not airborne or did not land again
  CRASHED if aircraft gear was not locked at landing).
- Airspeed in knots at touch down
- Sinkrate in ft/min at touch down
- Heading of aircraft at touch down in degrees.
- NAV1 frequency and Identification
- NAV2 frequency and Identification
- Max. Bank angle during the whole flight in degrees
- Max. pos. pitch during whole flight in degrees
- Max. neg. pitch during whole flight in degrees
- Fuel before takeoff (aircraft at terminal) in lbs.
- Fuel after landing (aircraft came to full stop) in lbs.
- Fuel used during flight in lbs.
- The landing position is calculated against tuned NAVs. One of them must be the ILS of the landing runway. The results of calculation are: distance from centreline of runway, and distance to touch down area of runway.
- ATP rating for airmanship, Safety and Efficiency.
- ATP error list. For viewing that list press F3.

ATPUTIL is now able to create an empty order, which allows full functionality, but airlines will not recognise such orders.

Data to be entered:
Pilot's name (just for information)
password (to be entered in assignment window)
Aircraft's name (just for information)
Reliability (0 to 99%, bigger values indicate less chance of failures
Assignment Number (according to predefined career assignments: 0-96)
Turbulence (none, light, heavy)
Thunderstorms (Yes, No)
Forced Failures at a specific time of flight
A comment.

ATPUTIL will generate the file "AIRFLT.CIS" directly, no renaming etc. is needed.

Using Airline.DRV to enhance your Assignment flights: Special features introduced with ATP AROUND THE WORLD Scenery.

For the adventures with the "Around The World" scenery, some additional functionality has been introduced. If the order file "AIRFLT.CIS" does not exist, AIRLINE.DRV will look into the ATP directory for a file AIRFLT.Cxx after an assignment number has been chosen, where xx matches the selected assignment number (e.g. if the user selects assignment 07 to be flown, AIRLINE.DRV will check for order file AIRFLT.C07). If that file exists and the order file has been created for that assignment number, then the user is allowed to log into the flight.
The results however will not be written over that order file, but in a separate result file named "AIRFLT.Rxx" (in our example therefore AIRFLT.R07).

AIRLINE.DRV now supervises the weather setting of career assignment. If the user decides to abort a landing attempt to the designated destination airport and diverts to another airport, the weather will be set to cruise weather conditions again, after the aircraft has left the area of destination airport (about 35 miles distance). If the aircraft enters that area again, the weather will be set to the career setting for arrival again. This procedure will enable a successful landing at a diversion airport, even if the destination weather was below minimums, so that a missed approach is required. As the weather won't change in original ATP, a successful landing would not be possible at any airport.

Of course you can create your own Airflight files as outlined above and then manually copy them onto free slots. If you want to e.g. add an Airflight file to your career assignment 20, create it as outlined above, then rename the resulting AIRFLIGHT.CIS file into AIRFLIGHT.C20. Make sure you don't overwrite existing ones! Also before using them, make sure that no AIRFLIGHT.CIS file is still available in the directory.

Other ATPUTILITY Programs

ATPUTILITIES 5.0 is a part of a powerful programming system, which can be found in Compuserve's SIMPILOT forum. Check Online for the latest news and versions of this tool.

Ernie

Ernie is a valuable tool for you to look at sceneries and to follow flight progress over a network. It installs with a Setup routine which is located on the CD-Rom in a folder called \ERNIE\.

Ernie has 2 main tasks: It allows you to see the installed scenery in a bird eye view and therefore allows you to find your way around. The second task requires a 2nd computer. You may use Ernie to watch your aircraft move over the scenery, if you have a second computer connected via IPX network to the one running AS2.

For more information, please consult the documentation included with Ernie.

SCONLINE

SCONLINE has become an institution for the members of the Simpilot forum. It is an effective online tool, which allows multiple AS2 users to fly in a common environment within Compuserve's SIMPILOT forum. SCONLINE requires to be set up on a second computer and connected via IPX network, if you want to fly yourself, or, if you merely want to watch, you can use it also on your main machine.

SCONLINE is available on the CD in a folder called \SCONLINE\ and can be installed using the SETUPSCO command.

Visit Compuserve's SIMPILOT Forum and consult the included documentation to know more about our Online Flying World.

Voice Commander

Voice Commander is a software that allows control of AS2 and particularly it's ATC over a microphone. It is included on the CD as shareware. Please read the documentation which comes with it.

Appendix

Advanced Installation

If you have a video card made by ATI (ATI Mach 64 or Mach 32) or a video system based on these chips, or a video card based on the S3 chipset you can increase the programme performance considerably by customising your setup to install the accelerator drivers written for these chip sets. If you own one of these graphics cards, you can install the special drivers available for them using the setup program. These accelerator cards will provide you with much faster graphics than the standard VESA selection.

On installing such a graphics driver you will need to run AS2 from pure DOS or DOS Mode (Win9x). For the ATI Mach32 copy IALATI32.GRA over CGA1.GRA (in DOS prompt:: COPY IALATI32.GRA CGA1.GRA)., for the ATI Mach64 and Rage products (not Rage 128!) you'll need IALATI64.GRA (COPY IALATI64.GRA CGA1.GRA) and for S3 based graphics boards it's IALS3.GRA (COPY IALS3.GRA). To restore back to VESA compatible graphics copy IALVGA8.GRA (COPY IALVGA8.GRA CGA1.GRA). If you are using Windows 95 or 98, using an accelerator will mean that every time you start AS2 your PC must go into DOS mode rather than stay in Windows mode. This is normal and is required in order to force Windows to move out of the way, and free up the system resources needed for the AS2 advanced graphic drivers to run at peak speed.

Using Airline Simulator 2 with former ATP add-ons

Airline Simulator 2 comes with a lot of scenery covering Europe, the North Atlantic and USA in quite some detail. Most of the older add-on scenery is therefore obsolete and does not contribute anything sensible to AS2. However, there may be users who wish to still use these sceneries, and we certainly don't prevent it. In the chapter below, we give you some indications on how to use these sceneries with AS2.

General considerations using ATP add-ons with AS2.

How will the ATP add-ons be represented within AS2?

The ATP add-ons will not match the new graphic representation of 256 colours of AS2. Watch out on SIMPILOT and other AS2 sites for updates that will come forward with time.

Co-ordinate System Issues.

ATP uses several different co-ordinate systems to comply with the latitude - longitude conversion and to trigger the Autoload values within AS2. Some of these systems do not mix easily with AS2's system which was designed to cover all of Europe and the North Atlantic.

The original Co-ordinate System numbers were:

0.	ATP default	Standard ATP scenery, also used by ATP around the World (see below)
1.	subLOGIC Japan.	integrated in AS2
2.	Great Britain	NOT compatible with AS2!
3.	subLOGIC Hawaii.	integrated in AS2
4.	USA	integrated in AS2
5.	Europe and North Atlantic	integrated in AS2

As the co-ordinate system numbers also drive the FMC and EFIS databases, it is quite important to understand the significance of them.

Importing your older sceneries to work with AS2.

AS2 and ATP sceneries have a very easy to understand format. The sceneries consist of the following file types:

*.SCN *.SP1 *.SP2 and *.SP3	Scenery files
*.SMS	SMS files (Waypoint databases)

You can therefore install most sceneries very easily by simply copying the respective files into the proper directories within AS2. The below list gives you the instructions and some comments to the disks. NEVER USE THE BUILT IN INSTALLATION PROGRAMS AS THEY MAY DAMAGE AS2:

Remark: For some of the disks you need a so called PKUNZIP utility. The DOS version is called PKUNZIP.EXE and can be found on e.g. the Swiss Scenery Disk, the Windows Utility is called WINZIP and can be found on CompuServe „Simpilot„ and many other on line sites. Be sure to be acquainted with these tools before attempting to use them.

subLOGIC Japan / Hawaii:	Use the CONVERTS.EXE program that came with AS2. Place the disk in your disk drive and enter CONVERTS at the command line. Once the scenery is converted, it is advisable to move it into the \AIRSIM2\Scenery\ directory.
subLOGIC USA East and West	These sceneries are included with AS2
subLOGIC California	This scenery is obsolete by AS2
Flylogic Swiss Scenery for ATP	From the „SCENERY.ZIP„ archive on the installation disk 1 unzip all *.SCN *.SP1 *.SP2 and *.SP3 into the AS2\SCENERY directory. Also unzip the *.SMS file from the same archive to the AS2\SMS directory. CAUTION: The EFIS and FMC support for the Swiss Scenery is not 100% accurate under AS2 but should be sufficient to use for navigation. To use the career assignments, you need to obtain a file called SWITZ.ARC which can be used as an ATC archive. It is available on Simpilot and on the Mailsoft Web Site (WWW.MAILSOFT.COM).
LAGO Italy	Unzip the SCN.ZIP, SP1.ZIP, SP2.ZIP, and SP3.ZIP files into the AS2\Scenery directory. The ITALY.SMS file can be found in the SUPPORT.ZIP archive of the installation disk.
Aerosoft Germany	These 2 sceneries are not suitable to be used directly with AS2, as they use an subLOGIC Great Britain incompatible co-ordinate system, which is no longer used. In order to use them, you would need to set up a different directory and install AS2 again, then remove the sceneries there and reinstall Germany and Great Britain.
Flylogic ATP around the world	ATP around the world is officially supported by the AS2 team. It can be relatively easily installed by simply using the install routine included in the ATW disk. To use the new planes with ATW, you need to obtain a patch, which will be available in the SIMPILOT Forum in Compuserve shortly after release of AS2. The flight assignments have been reassigned to work with the new aircraft. For more information please see the ATW.TXT document which comes with the Patch. The patch can be found on your AS2 CD under the directory ATW.

Using the High Resolution Graphics Drivers for DOS

99% of all computers will accept the preinstalled VESA driver, giving you a clear picture from the start of the installation. However, AS2 has some accelerator drivers that will perform significantly better than the standard VESA driver. In order to use these drives, you have to know a few things about your computer. If you are unsure what graphics card you own, we advise you to leave the configuration untouched for the time being and to consult your PC Dealer on which cards are in your system. AS2 supports high resolution graphics drivers for the following graphics cards:

ATI MACH 32 and MACH 64 series including ATI RAGE, XPRESSION, ATI 3D
Rage, ATI 3D Expression etc. All S3 based chipsets except S3 Virge.

If you have a graphics board as listed above, you can install special accelerator drivers to be used with AS2, provided you run AS2 directly under DOS and not in DOS-Box of Win9x. To use these drivers, change to your AS2 directory on the Hardrive, make sure to be at the DOS prompt and enter the following commands:

For the ATI Mach32:
COPY IALATI8.GRA CGA1.GRA

For ATI Mach64 (ATI 3D Rage):
COPY IALATI64.GRA CGA1.GRA

For S3 based cards:
COPY IALS3.GRA CGA1.GRA

To revert back to VESA compatible graphics (allowing operating under Win9x DOS Box):
COPY IALVGA8.GRA CGA1.GRA

All other boards such as MATROX, Cirrus, and other makes are supported directly via the default VESA driver.

Virtual Airlines

Want to expand your pilot's career? Reach new challenges? Compare your skills to other pilots? Fly within an airline like environment?

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There are no costs involved to become member and virtual employee of SunAir - but there will be no paycheck either, although members of the Airline joke frequently about their virtual paychecks, that are used as a measure of your career.

SunAir Express can be found on SimPilot Forum at
http://go.compuserve.com/simpilot and the web at
http://www.sunairexpress.com

SunAir Express - "Flying the airways of imagination!"

Further Reading

The compilation of this manual was a rather lengthy affair, and involved a huge research effort. In this spot, I would like to share some of my preferred reading with you, which can help you to further understand the implications of flying the heavy jets of today.

Airline Simulator:

On the CD-ROM, in the DOC folder, you will find a valued book on ATP:

THE ATP BOOK, by Martyn Thomas.
Worth printing

General Flying of Airliners:

Handling the Big Jets, D.P. Davies, Civil Aviation Authority, London, 1994. ISBN 0 9030083 0 1 9
In my opinion one of the best available books to cover the whole aspect of flying heavy airliners.

Boeing 747-400

From the Flight Deck 8, London Sydney, Philip J. Birtles, Ian Allan Publishing, Shepperton UK,1993. ISBN 0 7110 2213 5
Hands on account of a flight from London via Singapore to Sydney. Has many pictures and references usefull to the flight simmer.

MD 80

Startklar, ein Blick hinter die Kulissen des Luftverkehrs, Sepp Moser und Herbert Maeder, Orell Füssli, Zürich, 1981, ISBN 3 280 01239 2
In German, but worth it, as it shows an MD 81 in Operation on a flight from Zürich to London Heathrow.

Accidents / Incidents

While accidents are a sad chapter in aviation, a lot can be learned from them. Often enough, it is only through accidents and the specific accounts of them, that the PC pilot has a possibility to see crews at work and to learn from the mistakes made. In this genre, I can recommend the following books:

Air Disaster Vol 1-3, Macarthur Job, Aerospace Publications Pty Ltd, Weston Creek, 1994-1998.

Vol 1:	**ISBN**	**1 875671 11 0**
Vol 2:	**ISBN**	**1 875671 19 6**
Vol 3:	**ISBN**	**1 875671 34 X**

A compelling series of books written by a real aviation professional. Must read.

Air Disasters, Stanley Stewart, Ian Allan Publishing, Shepperton UK,1986, ISBN 0 7110 1585 6
Excellently written by a BA Captain, it will open your eyes to quite a few accidents.

EMERGENCY, Crisis on the Flight Deck, Stanley Steward, Airlife Publishing Limited, Shrewsbury, UK, 1989, ISBN 1-85310-031-5
Those that lived to tell their tale. Compelling, to the point, a must read.

Jet Engines:

THE JET ENGINE, Rolls Royce, Uk, 1986. ISBN 0 902121 04 9
The standard book on the jet engine and it's working.

AIRLINE SIMULATOR 2

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The Associates

Units A2/A3 Edison Road, St.Ives, Cambridgeshire PE17 4LF United Kingdom
Tel: +44 (0)1480 462748 Fax: +44 (0)1480 463070
Technical Support: +44 (0)1480 468075
Email: mail@theassociates.co.uk
Website: www.flightsim.co.uk